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W. T. TANG, *Acting Director*

SOME CONSIDERATIONS ON THE REGIONAL ADAPTABILITY OF RICE VARIETIES WITH SPECIAL REFERENCE TO THE RECENT DEVELOPMENT ON THE YIELD PER UNIT AREA IN TAIWAN

By EIKICHI ISO

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FOREWORD

In this report, the author by critically reviewing the previous research data of rice in Taiwan and considering the regional adaptability of rice varieties as a whole, intends to make clear the theoretical and fundamental idea of rice culture and breeding. It may be considered to be a continuation of Bulletin No. 1 of our Institute: "Summary of the Studies in the Correlation Phenomena among the Characters of the Rice-plant and its Application in Practice (1946)".

I believe this will contribute not only to the study of rice-plantation in Taiwan, but also to that in China Proper. So I have this report printed as a reference for all concerned.

W. T. TANG
Acting Director

Taiwan Agricultural Research Institute
Taipeh, Taiwan, China
October, 1947

PREFACE

The purpose of this report is to present the results of a study on the local adaptabilities of various rice varieties and an analysis of the possibilities for the development and expansion of rice culture in China and other areas based on the known variations in the adaptability of different varieties of rice to the natural climatic factors such as temperature and the length of day. It is recognized that the relative success of different rice varieties grown in a given region not only depends on climatic factors but also is affected by the soil type, methods of irrigation and drainage, methods of cultivation, and economic conditions. Thus the selection of the proper varieties in any area depends on two things: (1) the type of land use which provides the most efficient use of natural resources and (2) the material facilities available for production, such as fertilizers, power, and equipment, and the effect these facilities have on the type and intensity of production. This report is restricted primarily to a consideration of rice varieties in relation to the most efficient use of natural factors although the existence of the other important item determining the selection of varieties is recognized and pointed out in special cases.

The author does not profess to have a thorough knowledge of rice culture in China Proper but feels that with the facts at his command, certain theoretical benchmarks can be established which may be valuable as the basis for further study. Any suggestions or criticisms will be gratefully accepted and earnestly considered in the continuation of these studies.

The varieties analyzed are of Japanese and Taiwanese origin. These were selected because the Japanese varieties are produced in both cold and warm regions and in high and low latitudes while the Taiwanese varieties provide an excellent medium of comparison since some of them are grown even near the equatorial regions. Data and research findings on the varieties of the southern tropical regions and on types in other areas were not available to the author in sufficient quality and quantity to be included in the study.

It is suggested, however, that further studies along this line using the varieties in other regions might bring fruitful results.

The major aim of this exploratory study is to stimulate students in the same field to attempt to continue the work along similar lines to more definite conclusions with world-wide application. If this objective is accomplished, the author will feel well rewarded for his efforts.

EIKICHI ISO

September 15, 1947

CONTENTS

Chapter I. The Variety-groups by the Characteristics of Response against Day-length and Temperature..... 1

1. The variety groups by the characteristics of response against day-length and temperature and their regional adaptabilities. 1
2. Reversible change of heading character, early or late, according to the planting seasons. 8
3. Examples 13
   (1) Variations of days of vegetative growth under different combinations of day lengths and temperatures. 13
   (2) Reversible change of heading character according to localities and planting seasons. 23
   (3) Variations of days of vegetative growth and other characters according to dates of transplanting or dibbling. 28
4. Double cropping Rice 30
   (1) The kinds of double cropping method 30
   (2) The double cropping regions 30
5. The so called locally good variety 32
6. A general view of rice production in China and some considerations on varieties of the rice plant 33

Chapter II. Japanese Varieties and the Varieties in Taiwan 41

1. Origin of the Japanese varieties and the Japanese varieties in the present age. . 41
2. Representative Japanese varieties and the marginal limits oft heir local distribution. . 44
3. The adaptabilities of Japanese varieties in the cold regions of high north latitude. . 54
   (1) Hokkaido varieties. 54
   (2) The experimental results of Hokkaido varieties in Manchuria (Tables). . . 55
   (3) Comparisons of the day-lengths and temperatures of the rice-growing season in the cold countries (Tables). 61
      i. Hokkaido and the first crop season of Taiwan. 62
      ii. Hokkaido and Primorskaya. . . . .
      iii. Hokkaido, Northern Honshu, Korea and Manchuria. 63
      iv. Days free of frost. 64
4. The varieties in Taiwan. 64
   (1) The native varieties. 64
   (2) Japanese varieties with special reference to the adaptabilities in the tropical . 64

regions of low latitude. 68
(3) *Horai* varieties. . . . . .
Chapter III. **The Yield of Rough Rice per Unit Area**.....
1. Comparison of the yield of rough rice per *tan* on the China mainland, Taiwan, Japan and Korea. . . . . .
2. A consideration on the recent development of the yield per unit area in Taiwan, before 1921 and after 1922. . . . . .
Conclusion.....
Appendix. 97
1. Local planting seasons of native varieties of the rice in Taiwan. 97
2. Taiwan cities and districts Romanized. 101
3. Chinese cities Romanized. 103
4. Chinese reading of Korean native varieties of the rice. 104
5. Weights and measures 104
References. 105

SOME CONSIDERATIONS ON THE REGIONAL ADAPTABILITY OF RICE VARIETIES WITH SPECIAL REFERENCE TO THE RECENT DEVELOPMENT OF THE YIELD PER UNIT AREA IN TAIWAN

By

Eikichi ISO

Chapter I. The Variety-Groups by the Characteristics of Response against Day-Length and Temperature.

1. The Variety-Groups by the Characteristics of Response Against Day-Length and Temperature and their Regional Adaptabilities.

The rice plant has an inclination that the action of its heading and ripening works as the length of daytime becomes short, so it is called "short day plant". But in certain phases of its growing period one can see that long days rather prompt its heading. This degree varies according to the length of daytime, temperature and varietal character. Therefore this action, after all, works as the reaction—(**X Y Z**) (for the convenience of expression, these symbols are used)—of characteristics of varieties (**Z**) to a combination of day-length (**X**) and temperature (**Y**). And in the factors of **XY**, sometimes **X** acts more strongly to **Z**, and *vice versa*, sometimes both **X** and **Y** act strongly. Biochemically, it is considered that these differences arise from quantity and quality of carbohydrate and nitrogenous matter and their assimilation ratio in the growing course and physiological and ecological sequences. As a short day plant, the shortest heading and blooming of rice, that is, the inherent minimum days of vegetative growth or the nature of earliness (**V**) and lateness (**v**) of blooming, may, however, be effected by the combination of day-length and temperature, differing in each variety. Such effects of

day-length and temperature have a certain limit. When they deviate too much, the time of heading and blooming may be delayed or even the blooming may not occur. This delaying probably depends upon the inherent nature of each variety (**Z**). Every agriculturist must be familiar with the growing habit of each variety: how in the growing course each organ of the rice plant appears as rudimentary body in growing point and how it grows remarkably and reaches the final size after gradually developing, differentiating and accomplishing the fundamental and preparatory construction. He must choose and culture a fit, excellent variety at a suitable period. He must also devise how he can harvest the greatest quantity of excellent production in the ripening period when the plant accomplishes its construction and contents. Day-length (**x**) and temperature (**y**) which cause inherent minimum days of vegetative growth do not always exist in natural environments, but often so within artificial arrangements. The inherent minimum days of vegetative growth varies with varieties, and thus it may be assumed that the inherent earliness or lateness of the variety is independent. Furthermore, local or seasonal variation of earliness or lateness should also be considered. The normal and economically profitable yield is not solely controlled by inherent minimum days of vegetative growth and must be attained by selecting suitable culturing locality or season.

The following is a classification of the varietal groups.

Variety-Group 1 (X$\ddot{S}$, YS, V). [1]

Sensibility is very sharp, short day promotes heading and long day postpones it (**X**$\ddot{S}$). At the same time temperature gives acute influence (**YS**). As inherent minimum days of vegetative growth are short (**V**), in short day regions of high temperature in low latitudes the plant has the nature of earliness. Especially as in the second crop of double crop localities it is in high temperature from the early stage of growing and gradually becomes short day during the culturing period. Therefore the plant matures earlier.

1) The mark $\ddot{}$ shows the idea of day-length acting as short day. The more the number of this mark is, the longer the day-length is.

Thus for economical culture one must make to the utmost use of the correlation between days of nursery and days from transplanting to heading (*i. e.* correlation coefficient:—1st crop, Taiwan-0.82, 2nd crop-0.99) and he must prolong the growing period by transplanting young seedlings. By doing this, it is necessary to plan vigorous growing and full yield. However, in a comparatively long day region of high temperature in high latitude the plant grows early-late or late, and it is easy for the plant to grow in an economically normal condition.

Variety-Group 2 (XS̈, YS, V). This may be recognized as the same type of variety-group 1. But the degree of short day is different. Day-length which acts as a short day to variety-group 1 acts still as a long day in the case of variety group 2. Therefore this group is well fitted for the second crop of a double crop locality of low latitude and high temperature. Ex. 2nd crop of native variety, Taiwan.

Variety-Group 3 (Xs, YS, V). This has dull response to day-length. It is not striking that heading is prompted by short day and is postponed by long day (**Xs**). But temperature prompts it strongly (**YS**) and inherent minimum days of vegetative growth are short (**V**). Therefore in spring and summer of high latitude, especially in cold climate of long day, the plant heads by the rise of temperature and the growth becomes better. In a short day region of high temperature in low latitude the plant, by the influence of temperature, heads the earliest. Ex. the varieties of Hokkaido.

Variety-Group 4 (Xs, Ys, v). Sensibility to day-length and temperature is relatively dull (**Xs, Ys**) and inherent minimum days of vegetative growth are long (**v**). Therefore in the first crop of short day region of high temperature in low latitude, as in Taiwan, the growth is good. (During the growing period of the first crop in Taiwan, the temperature is lower than that of the growing period in Japan Proper and Hokkaido. So that when sensibility is sharp, heading is delayed.) *i. e.* 1st crop of Taiwan native varieties.

This is a rough classification based upon what one can clearly recognize. When one observes more minutely, he will find the following varieties. For

instance among Taiwan vatieties, there is one whose characteristic is intermediate between varieties of lst and 2nd crops, the one which is unique in sensibility to day-length and temperature, in constituent of inherent minimum days of vegetative growth and then whose yield is good in both crops. *i. e.* In the central part of Taiwan (Taichu Pref.) varieties of 2nd crop, *Sngkang, Keha, Gokichoe, Chhiko, Angkha-chut, Lamto-chut, Banghoe-chut, Okak-chut* are planted as lst crop varieties. So are such 2nd crop varieties in the southern part (Takao Pref.) as *Pekkak-chut, Chiam-chut, Peh-chut, Angkha-hut, Okhak-chut.* On the other hand, such lst crop varieties as *Poanthia, Ochiam, Pekkakku, Chianthau-Gonug-chut* in the central part of Taiwan, *Okkak chhengui, Oliap, Inliap, Thongheng, Okkak, Okkachenyu, Pekkhak chhengiu* in the southern part are planted as 2nd crop varieties.

I visited tropical regions several times. These places are short day regions. Under the strong light and heat the difference between dry and rainy seasons is extremely distinct. In rainy seasons, water of rivers and lakes flood and then planting seasons and methods of culture are quite controlled. And in winter, temperature falls so little that the growing of the rice plant is hardly interrupted. Accordingly in this season the planting in the environment of the shortest day-length is possible. There are many types of culture of early varieties making use of the short period of long day and high temperaure—the period between general lst and 2nd crops, also in general types of double crops, except these special cases, the environments of day-length and temperature are different from those of Taiwan and the main land (Southern Maritime Provinces of China Proper) (Tables 1-3). Among the varieties cultured in tropical regions, in form, or physiologically and ecologically, there are those which are strikingly different from Taiwan native varieties or Japanese varieties. Accordingly variations of each character as above-mentioned are very numerous and there are different combinations of them. Therefore it may be proper to classify them by other variety-groups. But this problem requires further study in the future. What I have mentioned so far is based on the experimental records except for the

latter unsolved tropical varieties.

By cross breeding different types are developed. "*Horai*" varieties represent one of these cases. Comparing with native varieties of lst crop, the response of many *Horai* varieties to day-length is strong, that to temperature is weak, inherent minimum days of vegetative growth are long (XS, Ys, v). This combination leads an excellent yield through both crops, compared with Japanese variety of variety-group 1. In an attempt at an abundant harvest with much fertilizer and in an intensive method, the total harvest of both crops in the same field is 100-120 *koku* (rough rice) per *ko*, or everywhere one can expect a harvest of 30-40 *koku* (rough rice) per *ko* in each crop. This amount can be said to be the highest in general planting. These records are of this new type, "*Horai*" varieties. In tropical regions where it is quite impossible to economically plant Japanese variety belonging to variety-group 1, these varieties can give an excellent yield by transplanting young seedlings in places of satisfactory irrigation and drainage. The varieties belonging to this type were possible to grow up as a result of the fact that populations produced by crossing were selected twice annually by planting both crops alternately, each differing in natural environment. And it is worthy of notice that this type was also produced by crossing varieties among variety-group 1. In the case of native varieties, those which produce satisfactory yield in both crops are considered to be selected in the same way.

Table 1. Dates from Sowing to Ripening in Cochin China

Cochin China	One crop-field in rainy season			Twice Transplanting field	Floating rice	Rice in fall season of flood	Double crop field	
	Early rice	Half seasonal rice	Seasonal Rice				First crop	Second crop
Time of sowing (month, decade	May 3rd-June lst	June 2nd	June 3rd	May last	May lst-last	Nov. lst-2nd	May lst-last	Sept. 2nd-last
Time of transplanting (month, decade)	July lst-2nd	Aug. lst	Aug. 3rd	lst trans. July lst 2nd trans. Aug. lst	—	Nov. 3rd Dec. lst	June 2nd July lst	Oct last-Nov. lst
Days of nursery period	35—45	50	60	lst trans. 40 2nd trans. 50—60	—	25—30	35—40	40—50
Time of heading (month, decade	Aug 2nd Sept. 3rd	Oct. 2nd Nov. 2nd	Nov.3nd Dec.2nd	Dec. 2nd-Jan. 2nd	Nov 2nd Dec 2nd	Jan.l st-Feb.2nd	Sept. lst last	Jan. 2nd
Days from transplanting to heading	50—70	70—100	90—120	from 2nd trans. 180—200	from-sowing 180—200	40—60	70	70—80
Time of ripening (month, decade	Sept. 2nd Oct last	Nov.2nd Dec. last	Jan. lst-last	Dec Jan.	Declast-Jan. 2nd	Fed.lsst-Mar. 3rd	Oct. lst last	Feb. 2nd
Days from heading to ripening	30—40	30—35	30—35	35	35	25—30	30	30

Table 2. Dates from Sowing to Harvesting in Tongking

Tongking	Paddy of May (Annam Calender)			Pnaddy of October (Anam Calender)			Remarks
	one crop a year	Double crops (2nd crop-Oct. paddy)	Three month-rice	One crop a year	Double crops (1st crop-May paddy)	Rotation with oth r crops	
Time of sowing	Oct. 10-Nov. 15	Oct. 20-Dec. 1	May1-30	May15-June 17	May15-June30	May 15-June 30	
Time of transplanting	Dec. 15-Jan. 15	Dec. 25-Feb. 1	May 30-June25	June 30-Aug. 20	July 10-Aug 15	June 30-Aug. 20	
Days of nursery period	50—75	50—75	25—30	25—40	30—45	25—45	
Days from transplanting to heading	Many kinds	〃	35—40	Many kinds	〃	〃	about same time on heading
Days from heading to ripening	〃	〃	20—25	〃	〃	〃	
Time of harvesting	May15-June 10	May 15-June 30	Aug. 10—20	Sept. 5-Nov. 30	Sept. 15-Nov. 15	Sept. 15 Nov. 1	〃

Table 3. Dates from Sowing to Harvesting in India and several other Countries

Localities	Kinds	Sowing seasons	Harvesting seasons	
India — General	Summer paddy	Jan——Feb.	May——June	
	Autumn paddy	May——June	Sept.	
	Winter paddy	May——Aug.	Dec.——Jan	
India — Madras	First crop	Apr.——Oct.	Sept.——Mar.	
	Second crop	Sept.——Mar.	Jan.——May	
Burma	Spring Paddy, dry weather paddy	Dec.——Jan.	May	Upper Burma
	Summer paddy	Mar.	June	
	Autumn paddy, early rain paddy	Apr.——May	July——Aug.	
	Winter paddy, late rain paddy	June——July	Dec.——Jan.	Lower Burma-Rangoon rice
Siam	Earliest paddy	May	Oct.	
	Early paddy	June——July	Nov. ——Dec.	
	Intermediate paddy	June——July	Dec.——Jan.	
	Late paddy	June——July	Jan.——Mar.	
Philippines	First crop rainy season	May	Oct.	Mostly one crop a year
	Second crop dry season	Oct.——Nov.	Feb.——Mar.	Irrigated field only
Java		Jan.——Feb.	May	Every month
U. S. A.		Mar. 2nd decade-May 2nd decade	Aug.——Oct.	
Brazil — Sao Paulo		Oct.	Jan. 1st decade	
Brazil — Table-land		Sept,——Oct.	Jan 1st decade	
Brazil — Coast		Nov.——Dec.	Jan——May	
Brazil — others				
Greece		Spring	July.——Sept.	
Italy		Mar.-May 1st decade	Aug. (end)-Sept. (end)	
Egypt		End of Apr.-May 1st decade	Oct.——Nov. 2nd decade	
Spain		Mar.	Sept.	

Note:—

A general inclination of variety tests in Taiwan is this: in both crops, varieties of the higher latitude head earlier than Taiwan native varieties, on the other hand those which belong to the lower latitude regions head later. The varieties in the Southern-Maritime provinces of China mainland are in heading, similar to Taiwan varieties, and with respect to varieties in and other regions, in both crops Japanese varieties are the earliest, Taiwan native comes next others head late. The following is an outlines of varieties from different regions.

The Philippine varieties;—

Some of them, in the first crop, head almost at the same time as late varieties of Taiwan native or head little later than the latter. But in the second crop their heading becomes late or extremely late. Others head extremely late in both crops and the heading period of the 1st crop corresponds to that of the 2nd crop.

Dutch East Indies varieties:—

In the first crop the heading period varies from the same time as the latest Taiwan native varieties to the beginning of September. Many varieties head in August. In the second crop there are many varieties that head extremely late.

French-Indian varieties:—

The heading period of the first crop is various, *i. e.* it varies from those varieties which head at the same time as Taiwan native to extremely late ones or the ones heading at the same time as the second crop. In the second crop there are many kinds varing from those whose heading period is the same as Taiwan native to the varieties of extremely late heading. The varieties in Tonking are similar to Taiwan native varieties of 1st and 2nd crops but many varieties head a little later than Taiwan ones.

Indian varieties:—

In the first crop there aye those which head extremely late and whose heading period corresponds with that of the second crop. There are some that head late as the second crop. A small number of varieties in both crops head at the same time as Taiwan varieties. A few head at the same time as Japanese varieties.

Thus heading displays variations adjusted to day-length and temperature according to latitude. It has an inclination to be geographically selected and originate the varieties of each locality; and one can recognize the successional variations on these characters from high latitude to low latitude. Thus there are originated geographically the variety-groups of the temperate, southern temperate, subtropic and tropic; first and second crop varieties in subtropic and tropic; the differences of morphological characters.

2. Reversible Change of Heading Character, Early or Late, According to the Localities or the Planting Seasons.

As I mentioned at the outset of this paper, nature of earliness, early-lateness, or lateness of heading in planting area is the determinants by which inherent earliness or lateness is demonstrated in every locality. When planting seasons are different, the same thing can be said. Therefore if two different varieties are planted in two localities of extremely different temperature and day-length, it sometimes happens that earliness or lateness of heading in one locality is opposed to that of the other locality. Here is pertinent record (1911): There are such varieties as *Miyako* and *Shiratama* which are planted in Japan as early-late varieties. Men tried to plant them as lst crop at Taihoku, Kyushu, Shikoku, Sanyo, Kinai, Tokyo and Hokuriku districts. While growing days were 69 days in Shikoku and 84 in Hokuriku district, these varieties, in lst crop, at Taihoku where temperature was lower than in the above-mentioned places, grew the earliest, the growing days being 68 (Table 6).

Tekonghoele, in Taihoku is later than the Japanese variety *Nakamura*. But when it is planted in Shizuoka, it grows earlier than *Nakamura*, which strikingly postpones its growing period and becomes early-late variety (Table 7-1).

Though *Taichu* No. 65, *Horai* variety is later than Japanese variety *Asahi*, the latter cultured in Osaka grows later than *Taichu* No. 65 (Table 7-2).

In general, Japanese varieties belonging to variety-group 1 grow earliest in Taiwan, but in the Japanese meteorological environment they have the nature of lateness. Though temperature during the growing period of Taiwan 1 st crop is lower than that during the growing period of the rice plant in Japan, heading is early. This is because short day-length has a strong influence. In Japan long day-length causes lateness of the rice plant, as is seen in the cases of *Miyako* and *Shiratama* in Japan. They are latest in

Hokuriku district when the day-length is longest.

The rice planting in Japan, excepting Hokkaido and some of the north castern provinces, or other special cases, rests on the bases of variety-group 1 and by applying skillfully adaptability to the meteorological environment an abundant yield is produced. Between two places less distant, these phenomena can be seen. When the first crop Taiwan native varieties as *Oliap*, *Thougheng*, *Lonkiau*, and *Pehhioh* planted on February 10 in Heito, are planted in Taihoku on April 6 in the same year, heading comes a little earlier. Though day-length during the growing period is longer in Taihoku, higher temperature than that in Heito seems to be a cause.

As far as cultural seasons are concerned, such varieties as *Angkha-Chuit*, *Banghoe-chuit* have the nature of lateness in lst crop, while belonging to the early group in 2 nd crop.

If such Japanese varieties as *Miyako*, *Nakamura*, *Edo*, *Sagamansaku*, *Kinchaku* which belong to variety-group 1 are cultured in Kagi situated in the south central part of Taiwan, growing days of those planted in May are, in spite of high temperature, longer than those planted in April (1913). This is owing to longer day-length as compared with growing period of April-planted rice.

Here is a record to note: *Asahi* (Japanese variety belonging to variety-group 1), *Taichu* No. 65 (*Horai* variety), *Ochiam* (native lst crop variety), *Chhinko* (native 2 nd crop variety) are sown (not transplanted) on the first day of each month from January to July (1933). The order of heading of these varieties is as follows:—

January- and February-sown,

The earliest is *Asahi*, *Taichu* No. 65, *Ochiam*, *Chhinko* following it

March-sown,

The earliest is *Asahi*, *Ochiam* comes next; then *Taichu* No. 65 and *Chhinko*.

April- and May-sown,

Asahi becomes late Then the order is *Ochiam*, *Taichu* No 65,

Asahi and *Chhinko.*

June- and July-sown,

Asahi is the earliest. The same order of January- and February-sown case.

The lateness of April- and May-sown *Asahi* has just the same phenomena as *Nakamura, Edo, Sagamansaku* and *Kinchaku* which have already been mentioned. That is, in the Japanese rice planting though temperature is highly activating the growing period of variety-group 1, long day-length is a factor to prolong the period of vegetative growth, from sowing (no transplanting) to heading or from transplanting to heading, and to allow to grow late, and the heading period is between the middle of July and the beginning of August in which temperature is about 27.5°C, day-length is shortened to about 13 hours. This corresponds with the heading period in Japan. For in Japan it is the end of August or the beginning of September when the temperature is about 24°C and day-length is shortened to about 13 hours. However the degree to become late is lower than in Japan. Perhaps it is because the day-length during the growing period is shorter than that in Japan and also because the period in which the day-length necessary for the prolongation of the period of vegetative growth is beyond a certain limit, is short.

This phenomenon is not confined to these varieties only. It occurs in *Tosashinriki, Tangochuto, Iwata Asahi, Kagi Ban* No. 2 (selected from *Iyosen-goku*) (Table 8-(1-3), 1932, 1936). Making use of this phenomenon, men often experimented with the planting to get abundant harvest by one crop of Japanese varieties in intermediate crop season. But they always failed because the heading was not uniform. Here one can think of characteristics of meteorological environment which brings abundant harvest to Japanese rice planting by variety group 1.

Concerning the words, short day and long day, they, strictly speaking, imply comparative meaning, too. It is difficult to regulate them as a whole by uniform day-length of one day. According to temperature and varieties the limiting boundaries are different. Though the inclination that heading is

prompted by short day is the same, yet there is a case that the limiting boundary of each variety is different. That is, there are those varieties which are similarly sensible to short day, their heading being prompted by it. But while in A-variety 13 hours affects as short day and causes heading, in B-variety the same number of hours still affects as long day and causes slow heading. Here is a plain example in Taiwan. Plant Japanese variety belonging to variety group 1, both lst crop variety and 2 nd crop variety of Taiwan native, simultaneously in the lst crop. The Japanese variety heads as the earliest, the native lst crop variety comes next, both ripening and producing harvest. On the other hand, the native 2 nd crop variety does not head until the end of September which is the heading period of general 2 nd crop, sometimes it gradually dies without heading. This is because day-length over 13 hours in May acts still as long-day to 2 nd crop varieties of Taiwan native and can not prompt heading. Therefore if day-length is artificially confined to 9 hours every day in the lst crop, the above-mentioned 2 nd crop variety heads earlier than lst crop variety of Taiwan native. If the same method is tried in the 2 nd crop period, its heading comes next to Japanese variety and is little earlier than the lst crop variety of Taiwan native. In the lst crop variety sensibility to day-length is dull and the heading in long day in Taiwan is possible. Moreover response to temperature is not so sharp that low temperature in the first half of lst crop period hardly causes slow heading. Inherent minimum days of vegetative growth of the lst crop variety of Taiwan native are long. But the day-length of limiting boundary on heading is comparatively short. These characteristics enable this variety to head as lst crop and produce rich yield.

Heading and those phenomena which follow heading, as are divided into two periods, the formation of ears being a center, respond strongly to short day-length in the first half period while responding weakly in the second half. But still in the first half response is not strong for 30 days in the lst crop and 20 days in the 2 nd crop. On the contrary, if they are arranged in long day-length, there is an inclination that the heading period comes earlier. But

its degree is different according to varieties and sowing periods.

For instance, it is great in the lst crop but small in the 2 nd crop. And sensibility of those varieties which respond weakly to short day is also weak to the arrangement in long day during nursery period. Arrangement in short day during nursery period has the inclination to postpone the heading period. The effect of heading prompted by arrangement in long day, is conspicuous in the middle and latter parts, but if the arrangement in long day is done during the nursery period, it is scarcely effective.

Moreover if natural environment is artificially combined with short day, long day, high or low temperature variously, days of vegetative growth can be prolonged more than by arrangement only in long day or short day through the whole growing period.

The discovery of this fact has an important significance not only in the rice planting in Taiwan but also in general rice culture. The planting of new *Horai* varieties is based on the correlation phenomena between the days of nursery period and the growing phenomena after transplanting and also on the suggestion from those experimental results. To select and plant the most suitable variety by experiments in each locality, to find the best planting season, to study time of sowing, transplanting and days of nursery—these are only a means to accomplish agricutural purpose which follows the above-mentioned experimental results.

The so-called *Indica* type varieties are the key-note of the rice culture not only in China but also in tropical regions. Though I have some questions, I travelled in these regions several times and never heard that so-called *Japonica*-type varieties were being cultured. This fact may be proper, if natural environment, artificial conditions, sensibility to light and temperature and inherent minimum days of vegetative growth of *Japonica*-type varieties, which are known until to-day, are considered. But when, by intermittent experimental planting since 1929, *Horai* varieties are intensively cultured in Java, Sumatra, Malay, Philippines, Tongking, Hainan, and Kwangtung, more excellent results than native varieties are seen. It is quite note worthy.

3. Examples.

Here concerning the above-mentioned facts, the writer mentions the experimental results giving illustrations.

(1) Variations of days of vegetative growth under the different environments, the different combinations of day-lengths and temperatures (Tables 4-5).

(2) Reversible change of heading character according to the localities and cultural seasons (Tables 6-8).

(3) Variations of days of vegetative growth and other characters according to the dates of transplanting or dibblings (Tables 9-11).

Table 4. Accerelation Ratios of Heading ($\frac{D-d}{D} \times 100$) by Short Day-length and Temperature.

D. Days from transplanting to heading under natural condition.

d. Days from transplanting to heading under short day-length.

Crop season	Natural condition		Difference of temperature between natural condition and dark room
	Day-length	Temperature	
First crop	11.5-13.5hours	15-17°C	1-2°C higher in dark room
Second crop	14.0-12.5 „	27-25	

Varieties	Acceralation ratio of heading			Varieties	Acceralation ratio of heading		
	First crop 9 hours	Second crop (7 hours)	9 hours		First crop 9 hours	Second crop (7 hours)	9 hours
Bana	25.2	(41.2)	48.5	Koain Khaochiam	8.4		6.7
Chutaku	16.7	(1.1)	18.5				
Taichu No. 110	13.4		28.9	Hiakongpau	12.5		5.1
„ No. 113	11.8		17.1	Toahoe	10.5		1.2
Taichu-mochi No. 1	10.1		17.5	Taichu Toku No. 2	6.0	(25.7)	4.1
Isenishiki	10.3	(−9.8)	14.5	Taichu No. 108	4.1		0
Taichu Toku No. 1	8.6	(6.2)	18.5	Taihoku Ban. No. 3	1.7		1.4
„ No. 6	4.6	(9.4)	17.2	Taichu No. 109	5.2		2.7
„ No. 4	6.8		23.2	Takao No. 3	6.6		0
„ No. 5	9.4		32.0	Shinriki	8.3	(−9.4)	7.8
Tainan Mii No. 1	6.3	(−16.4)	16.4	Ochiam	3.0	11.2)	1.1
Kagi Ban No. 2	6.9	(28.6)	11.7	Liu chiu	0.7		1.1

Omachi	7.0	(4.9)	14.5	Ekhaochiam	3.7		3.2
Asahi	3.6	(7.8)	15.6	Pehbihun	7.8	(29.9)	1.3
Kairyo Aikoku	5.4	(−3.1)	18.5	Tekonghoele	3.1		5.0
Nakamura	3.6		20.0	Pehhioh	7.0		2.1
„ No. 3	8.7		18.8	Kameno-o	3.7		1.6
„ No. 6	6.2		17.2	Gokhachoe	3.1		0
Edo	5.4	(9.2)	17.0				
Shirafuji	5.4	(8.1)	17.7	Keha	△	(38.9)	13.3
Chosen	4.5	(−53.2)	19.3	Chheng liu	△		51.6
Kinchaku	7.1	(−18.3)	13.3	Chiau ka	△		50.5
Miyako	8.5	(−58.7)	19.0	Toachhin ko	△		49.0
Sagamansaku	2.7	(−68.4)	15.9	Koain le	△		44.5
Poanthina	7.3		28.4	Goki choe	△		23.3
Banghoe-chut	9.2		21.1	In liap	△		46.8
Angkha-chut	4.0		10.1	Thian suncha	△		46.7
Chian-thau-gonug-chut	2.3		24.4				
Iyoshinriki	8.7		15.9	Taichu No. 36	−5.1	(−30.3)	-23.7
				„ No. 52	−3.4		− 6.0
Taihoku Ban No. 1	2.7	(−9.3)	8.0	„ No. 78	−9.2		−12.5
Taichu No. 8	0.9		7.6	„ No. 89	−6.1		− 8.3
Kaneko No. 1	0.9	(1.7)	3.3				
Niitaka	0.9		8.3	Taichu No. 64	−4.1		1.3
Taichu No. 54	1.7		2.7	„ No. 65	−1.3	(−32.9)	1.6
„ No. 111	7.3	(−26.9)	7.7	„ No. 88	−1.6		1.4
Koain khahoele	3.0		4.5				
Chatoahoe	3.0		4.8	Taichu No. 11	0.8		− 2.8
Luliaphoele	8.1		8.3	„ No. 27	4.1		−31.1
Pehkhak-chut	5.3	(39.3)	6.7	Kagi No. 1	5.8		− 1.5

Remark: △—no heading in the first crop.

Table 5. Variations of Days of Vegetative Growth under Different Combinations of Day-length and Temperature.

Varieties of Day-length (hours)			Temperature (°C)	
7	12-11.5 (Sept. 15)	13.5-14-13.5 (May 15)	11-12-23 (Nov. 15)	29-28 (July 15)
8	12	14-13 (June 15)	13-24 (Jan. 15)	
9	12-11-13.5 (Nov. 15)	14	17-27 (Mar. 15)	
10	12-13.5 (Mar. 15)	24	26-28 (May 15)	
11	13		27-28 (June 15)	
11-13 (Jan. 15)	13.5-12 (July 15)		28-19 (Sept 15)	

Remarks: ( ).—Dates of Sowing (no transplanted), showing under natural conditions.
Others,—Day-lengths were confined shorter or longer than natural day-lengths.

Temperatures and Day-lengths for the Shortest and Longest Vegetative Growth 1922-23)

Varieties	Days of Shortest vegetative growth				Days of longest vegetative growth				No heading		
	Dates of Sowing	Temperature °C	Length of Day hours	Days of Veg. growth Dates of heading	Dates of Sowing	Temperature °C	Length of Day hours	Days of veg. growth Dates of heading	Dates of Sowing	Temperature °C	Length of Day hours)
1. Keha	July 15	29-28	8	45 (Aug. 29)	Nov. 5	11-12-23	8	124(Mar. 19)			
2. Chhin ko	May 15	26-28	9	33 (June 17)	〃	〃	7	125(Mar. 20)			
3. Asahi	〃	〃	10	43 (June 27)	〃	〃	〃	143(Apr. 7)	All Sept. 15	28-19	24
4. Aikoku	〃	〃	〃	40 (June 24)	〃		〃	146(Apr. 10)			
5. Go-nug-chut	July 15	29-28	〃	34 (Aug. 18)	〃	〃	8	166(Apr. 30)			
6. Chia-thau-go-nug-chut	〃	〃	〃	56 (Sept. 9)	〃	〃	9	124(Mar. 19)	Sept. 15 July 15 Nov. 15	28-19 29-28 11-12-23	12-11.5 24 24
7. Rikuu No. 132	Mar. 15	17-27	12	68 (May 23)	Jan. 15	13-24	11	110(May 5)			
8. Ochiam	July 15	29-28	13.5-12	79 (Oct. 2)	Nov. 15	11-12-23	7	134(Mar. 29)	Sept. 15 Nov. 15	28-19 11-12-23	12-11.5 24
9. Chatoahoe	〃	〃	〃	75 (Sept. 28)	〃	〃	〃	129(Mar. 24)			
10. Taichu No. 65	〃	〃	〃	65 (Sept. 18)	〃	〃	8	165(Apr. 29)			
11. Akage	June 15	27-28	〃	41 (July 27)	〃	〃	24	130(Mar. 25)			
12. Akage	Sept. 15	28-19	11	41 (Oct. 26)							
13. Bozu	June 15	27-28	14-13	45 (Ju'y 31)	Nov. 15	〃	24	171(Apr. 5)			
14. Kameji	Mar. 15	17-27	10	64 (May 18)	Jan. 15	13-24	11	102(Apr. 27)			
15. Kyushu No. 8	〃	〃	〃	65 (May 19)	〃	〃	10	104(Apr. 29)			
16. Aikoku No. 20	〃	〃	11	57 (May 11)	〃	〃	11	94(Apr. 19)			
17. Kinugasawase	〃	〃	12	64 (May 18)	〃	〃	〃	104(Apr. 27)			
18. Hokubu No. 2	〃	〃	〃	63 (May 17)	〃	〃	〃	102(Apr. 27)			
19. Kairyoaikoku	〃	〃	〃	64 (May 18)	〃	〃	10	102(Apr. 27)			
20. Toyokuni	〃	〃	〃	71 (May 25)	〃	〃	〃	109(May 4)			
21. Shinriki	〃	〃	〃	64 (May 18)	〃	〃	〃	104(Apr. 29)			

Remark: Varieties 7, 14-21—No. sowing of May 15, June 15, July 15, Sept. 15 and Nov. 15.

2.

Days of Vegetative Growth under Different Combinations of Day-length and Temperature.

Varieties	Day-lengths (Sowing-dates) (hours)	Temperature (°C) VI 11-12-23	I 13-24	II 17-27	III-1 26-28	III-2 27-28	V 28-19	IV 29-28
Keha	7	126	99	57	56	—	55	45
Native 2 nd	8	124	99	57	49	—	55	45
Crop variety	9	134	96	56	48	—	54	50
	10	142	95	58	49	—	48	50
	11	—	112	65	—	—	—	—
	I. 11-13 (Jan. 15)	—	135	—	—	—	—	—
	V. 12-11.5 (Sept. 15)	—	—	—	—	—	83	—
	12	—	119	67	—	—	—	—
	VI. 12-11-13.5 (Nov. 15)	188	—	—	—	—	—	—
	II. 12-13.5 (Mar. 15)	—	—	128	—	—	—	—
	13	—	140	—	—	—	—	—
	IV. 13.5-12 (July 15)	—	—	—	—	—	—	84
	III-1. 13.5-14-13.5 (May. 15)	—	—	—	134	—	—	—
	III-2. 14-13 (June 15)	—	—	—	—	—	—	—
	14	—	—	—	—	—	—	—
	24	—	—	—	—	—	—	—
Chhiko	7	125	96	56	56	—	51	49
Native 2 nd	8	128	97	56	56	—	47	44
Crop variety	9	142	97	50	33	—	39	47
	10	146	111	63	48	—	46	51
	11	—	109	68	—	59	46	45
	I. 11-13 (Jan. 15)	—	147	—	—	—	—	—
	V. 12-11.5 (Sept. 15)	—	—	—	—	—	66	—
	12	—	110	72	—	74	94	51
	VI. 12-11-13.5 (Nov. 15)	213	—	—	—	—	—	—
	II. 12-13.5 (Mar. 15)	—	172	—	—	—	—	—
	13	—	125	—	—	—	—	—
	IV. 13.5-12 (July 15)	—	—	—	—	—	—	84
	III-1. 13.5-14-13.5 (May 15)	—	—	—	—	—	—	—
	III-2. 14-13 (June 15)	—	—	134	—	—	107	—
	14	—	—	—	—	—	—	—
	24	0	0	0	0	0	0	0

Varieties	Day-lengths (Sowing-dates) (hours)	Temperature (°C)						
		VI 11-12-23	I 13-24	II 17-27	III-1 26-28	III-2 27-28	V 28-19	IV 29-28
Asahi Japanese variety	7	143	101	64	55	—	62	63
	8	147	99	62	54	—	53	56
	9	160	98	62	49	64	52	52
	10	162	100	59	43	47	49	49
	11	110	104	104	—	—	54	51
	I. 11-13 (Jan. 15)	—	108	—	—	—	—	—
	IV. 12-11.5 (Sept. 15)	—	—	—	—	—	56	—
	12	112	105	105	—	—	—	53
	V. 12-11-13.5 (Nov. 15)	162	—	—	—	—	—	—
	II. 12-13.5 (Mar. 15)	—	—	67	—	—	—	—
	13	—	113	113	—	—	—	—
	VI. 13.5-12 (July 15)	—	—	—	—	—	—	57
	III-1. 13.5-14-13.5 (May 15)	—	—	—	68	—	—	—
	III-2. 14-13 (June 15)	—	—	—	—	66	—	—
	14	154	—	—	—	—	—	—
	24	0 182	0 127	0 82	87	—	0	0 74
Aikoku Japanese variety	7	146	100	59	59	—	55	54
	8	153	99 100	56	45	—	53	48
	9	159	100	59	43	—	48	43
	10	160	101	60	40	—	45	42
	11	—	106	64	—	—	—	—
	I. 11-13 (Jan. 15)	—	—	66	—	—	—	—
	V. 12-11.5 (Sept. 15)	—	—	—	—	—	48	—
	12	—	108	65	—	—	—	—
	VI. 12-11-13.5 (Nov. 15)	167	—	—	—	—	—	—
	II. 12-13.5 (Mar. 15)	—	—	—	—	—	—	—
	13	—	119	84	—	—	—	—
	IV. 13.5-12 (July 15)	—	—	—	—	—	—	59
	III-1. 13.5-14-13.5 (May 15)	—	—	—	—	—	—	—
	III-2. 14-13 (June 15)	—	—	—	—	—	—	—
	14	—	—	—	—	—	—	—
	24	—	—	—	—	—	—	—

		days	days	days	days	days	days	days
Gonug-chut	7	131	106	61	55	—	58	53
Native 2 nd	8	166	107	61	51	—	55	49
Crop variety	9	167	109	65	45	—	56	44
	10	169	109	65	45	—	48	34
	11	—	109	75	—	—	57	60
	I. 11-13 (Jan. 15)	—	245	—	—	—	—	—
	V. 12-11.5 (Sept. 15)	—	—	—	—	—	84	—
	12	—	129	—	—	107	—	74
	VI. 12-11-13.5 (Nov. 15)	—	—	—	—	—	—	—
	II. 12-13.5 (Mar. 15)	—	—	—	—	—	—	—
	13	—	0	0	—	—	—	—
	IV. 13.5-12 (July 15)	—	—	—	—	—	—	87
	III-1. 13.5-14-13.5 (May 15)	0	—	—	—	—	0	0
	III-2. 14-13 (June 15)	—	—	—	—	111	—	—
	14	0	—	—	—	—	0	0
	24	0	0	0	0	0	0	0
Chia thau-	7	168	118	79	77	—	106	76
Gonug-Chut	8	171	117	76	68	—	105	70
Native 1st	9	124	106	74	64	—	104	66
Crop variety	10	135	115	72	62	—	84	56
	11	—	124	82	—	62	—	72
	I. 11-13 (Jan. 15)	—	130	—	—	—	—	—
	V. 12-11.5 (Sept. 15)	—	—	—	—	—	0	—
	12	—	124	82	—	68	77 —	73
	VI. 12-11-13.5 (Nov. 15)	0 151	—	—	—	—	—	—
	II. 12-13.5 (Mar. 15)	—	—	85	—	—	—	—
	13	—	128	—	—	—	—	—
	IV. 13.5-12 (July 15)	—	—	—	—	—	—	0
	III-1. 13.5-14-13.5 (May 15)	—	—	—	112	—	—	74 —
	III-2. 14-13 (June 15)	—	—	—	—	—	—	—
	14	—	—	—	—	—	—	—
	24	0	153	94	112	—	0	0

Varieties	Day-lengths (Sowing dates) (hours)	Temperature (°C)						
		VI 11-12-23	I 13-24	II 17-27	III-1 26-28	III-2 27-28	V 28-19	IV 29-28
		days	days	days	days	days	days	days
Ochiam	7	134	128	92	91	—	106	87
Native 1 st	8	141	115	91	85	—	106	83
Crop variety	9	146	119	91	85	—	106	83
	10	158	100	90	85	—	106	81
	11	—	129	88	85	85	100	89
	I. 11-13 (Jan. 15)	—	125	—	—	—	—	—
	V. 12-11.5 (Sept. 15)	—	—	—	—	—	—	—
	12	—	129	88	—	82	—	86
	VI. 12-11-13.5 (Nov. 15)	179	—	—	—	—	—	—
	II. 12-13.5 (Mar. 15)	—	—	93	—	—	—	—
	13	—	131	—	—	—	—	—
	IV. 13.5-12 (July 15)	—	—	—	—	—	0	79
	III-1. 13.5-14-13.5 (May 15)	—	—	—	—	—	—	—
	III-2. 14-13 (June 15)	—	—	—	83	—	—	—
	14	—	—	—	—	103	—	—
	24	0 167	129 153	100	100	83	0 0	88 107
Chatoahoe	7	123	120	90	80	87	87	80
Native 1 st	8	132	120	86	80	83	83	80
Crop variety	9	145	115	86	80	82	82	79
	10	137	119	88	81	80	80	77
	11	—	131	88	—	—	—	—
	I. 11-13 (Jan. 15)	—	125	—	—	—	—	—
	V. 12-11.5 (Sept. 15)	—	—	—	—	126	126	—
	12	—	—	—	—	—	—	—
	VI. 12-11-13.5 (Nov. 15)	171	—	—	—	—	—	—
	II. 12-13.5 (Mar. 15)	—	—	90	—	—	—	—
	13	—	132	—	—	—	—	—
	IV. 13.5-12 (July 15)	—	—	—	—	—	—	75
	III-1. 13.5-14-13.5 (May 15)	—	—	—	—	—	—	—
	III-2. 14-13 (June 15)	—	—	—	—	—	—	—
	14	—	—	—	—	—	—	—
	24	—	—	—	—	—	—	—

Akage	7	—	—	—	—	—	—	—
Japanese	8	—	—	—	—	—	—	—
Variety	9	—	95	—	—	64	52	—
(Hokkaido)	10	—	95	—	—	60	50	—
	11	—	95	—	—	53	41	—
	I. 11–13 (Jan. 15)	—	105	—	—	—	—	—
	V. 12–11.5 (Sept. 15)	—	—	—	—	—	58	—
	12	—	93	60	—	53	70	50
	VI 12–11–13.5 (Nov. 15)	100	—	—	—	—	—	—
	II 12–13.5 (Mar. 15)	—	—	65	—	—	—	—
	13	—	95	57	—	—	—	—
	IV 13.5–12 (July 15)	—	—	—	—	—	—	47
	III-1. 13.5–14–13.5 (May 15)	—	—	—	—	—	—	—
	III–2. 14–13 (June 15)	—	—	—	—	**41**	—	—
	14	—	—	—	—	58	—	50
	24	**130**	103	76	—	—	—	65
Bozu	7	—	—	—	—	—	—	—
Japanese	8	—	—	—	—	—	—	—
Variety	9	—	98	64	—	74	52	52
(Hokkaido)	10	82	97	64	—	58	52	52
	11	—	97	63	—	53	50	53
	I. 11–13 (Jan. 15)	—	102	—	—	—	—	—
	V. 12–11.5 (Sept. 15)	—	—	—	—	—	55	—
	12	—	97	61	—	—	—	—
	VI. 12–11–13.5 (Nov. 15)	96	—	—	—	—	—	—
	II. 12–13.5 (Mar. 15)	—	—	64	—	—	—	—
	13	—	—	—	—	—	—	—
	IV. 13.5–12 (July 15)	—	—	—	—	—	—	—
	III.–1 13.5–14–13.5 (May 15)	—	—	—	—	—	—	—
	III–2. 14–13 (June 15)	—	—	—	—	**45**	—	—
	14	—	—	—	—	56	—	—
	24	**171**	107	85	—	—	—	—

Varieties	Day lengths (Sowing-dates) (hours)	Temperature (°C)						
		VI 11-12-23	I 13-24	II 17-27	III-1 26-28	III-2 27-28	V 28-19	IV 29-28
		days	days	days	days	days	days	days
Taichu	7	**173**	128	91	97	—	117	100
No. 65	8	165	119	90	85	—	104	93
Horai	9	170	108	86	83	—	111	87
variety	10	165	103	80	81	—	94	77
	11	—	119	84	—	93	—	94
	I. 11-13 (Jan. 15)	—	116	—	—	—	—	—
	V. 12-11.5 (Sept 15)	—	—	—	—	—	104	—
	12	—	121	83	—	87	—	93
	VI. 12-11-13.5 (Nov. 15)	171	—	—	—	—	—	—
	II. 12-13.5 (Mar. 15)	—	—	75	—	—	—	—
	13	—	124	—	—	—	—	—
	IV. 13.5-12 (July 15)	—	—	—	—	—	—	**65**
	III-1. 13.5-14-13.5 (May 15)	—	—	—	—	—	—	—
	III-2. 14-13 (June 15)	—	—	—	74	82	—	—
	14	—	—	—	—	—	—	—
	24	0	131 153	94	99	—	—	88 116

	I 13-24	II 17-27	I 13-24	II 17-27	I 13-24	II 17-27
	Rikuu No. 132 Japanese variety, Iwate Pref.		Toyokuni Japanese variety, Akita Pref.		Kinugasawase Japanese 2nd crop variety, Tosa Pref.	
9	111	73	110	74	109	67
10	110	72	109	67	107	67
11	110	70	110	75	104	66
I. 11-13 (Jan. 15)	115	—	120	—	111	—
12	110	68	112	71	109	64
II. 12-13.5 (Mar. 15)	—	73	—	76	—	75
13	112	—	120	83	110	**75**

Day-Lengths (hours)	Temperature (°C) (Sowing-dates)								
	15.2-14.7-26.6 (Jan. 31)			16.9-28.1 (Mar. 21)			27.9-22.9 (Aug. 7)		
	Shinriki Japanese variety	Taichu No. 65 Horai variety	Kameji Japanese variety	Shinriki "	Taichu No. 65 "	Kameji "	Shinriki "	Taichu No. 65 "	Kameji "
6	109	132	102	87	**132**	79	70	**116**	70
8	100	117	94	74	111	70	55	102	53
10	98	112	93	69	99	69	45	94	42
11	98	111	**90**	—	—	—	—	—	—
12	102	**110**	91	71	**95**	69	**43**	84	**41**
12.69-10.86	—	—	—	—	—	—	50	**73**	52
13	103	**110**	101	—	—	—	—	—	—
10.72-13.65	113	118	108	—	—	—	—	—	—
11.98-13.65	—	—	—	98	110	99	—	—	—
14	133	122	121	129	**120**	114	**106**	101	107
16	**166**	122	**153**	**131**	113	**120**	0	100	0
24	0	**148**	0	0	123	0	0	111	**171**

	Shimehari Japanese variety	Taino No. 16 Horai variety	Kagi Ban No. 2 Selected from Iyo-sengoku Jap. var			Toyokuni Japanese variety	Iwatasahi Japanese variety	Shimehari	Taino No. 16 "	Kagi Ban No. 2 "
6	108	118	113	100	116	98	81	81	104	104
8	100	107	110	93	85	87	73	56	83	90
10	95	107	107	**93**	81	**84**	**70**	44	68	**67**
11	97	**105**	**105**	—	—	—	—	—	—	—
12	**96**	107	107	97	94	86	72	**42**	**62**	**65**
12.69-10.86	—	—	—	—	—	—	—	45	69	**69**
13	101	108	108	—	—	—	—	—	—	—
10.72-13.65	106	124	121	—	—	—	—	—	—	—
11.98-13.65	—	—	—	98	105	91	115	—	—	—
14	121	145	144	95	131	97	125	96	115	131
16	**135**	**179**	**173**	92	119	100	**131**	133	**165**	**169**
24				**107**	**123**	**105**		**148**	—	—

Remarks: Taichu No. 65= Kameji×Shinriki
Taino No. 16=Shimehari×Kagi Ban No. 2

Table 6. Variations of Days of Growth Period of *Miyako* and *Shiratama* Early-late Varieties in Japan, 1911

Agr. Expt. Sta. in Japan	Kyushu.	Kinai	Sanyo	Shikoku	Hokuriku	Tokyo	Taihoku Taiwan
Dates of Sowing	May 4	May 6	May 2	May 2	Apr. 19	May 2	Feb. 5
Temperature °C	21.2	20.4	19.4	19.3	15.3	18.7	14.8
Day-length hours, minutes	13.34	13.51	13.32	13.12	13.22	13.38	11.11
Dates of trans-planting	June 21	June 22	June 21	June 20	June 3	June 19	Mar. 22
Temperature	25.7	25.8	24.9	24.7	22.2	24.0	16.9
Day-length	14.19	14.29	14.24	14.26	14.35	14.34	12.09
Dates of heading	Sept. 2	Aug. 31	Sept. 2	Aug. 28	Aug 26	Sept. 1	May 29
Temperature	28.3	30.2	27.8	28.0	29.1	27.8	24.1
Day-length	12.43	13.03	12.42	13.02	13.10	12.58	13.27
Dates of ripening	Oct. 17	Oct. 29	Oct. 22	Oct. 28	Oct. 23	Oct. 29	July 1
Temperature	21.7	17.5	19.5	18.6	17.2	16.5	28.2
Day-length	12.37	11.37	12.17	10.57	11.34	10.52	13.41
Days of nursery peried	48	47	50	49	45	48	45
Days of growing period	73	70	73	69	84	74	68
Days of ripening period	46	60	51	62	59	59	34
Total days	167	177	174	180	188	181	147

	Tem-pera-ture	Day-leng-th	Tem-pera-ture	Day-leng-th	Tem-pera-ture	Day-leng-th	Tem-pera-ture	Day-leng-th	Tem-pera-ture	Day-leng-th	Tem-pera-ture	Day-leng-th	Tem-pera-ture	Day-leng-th
Feb.	—	—	—	—	—	—	—	—	—	—	—	—	14 8	11.11
Mar.	—	—	—	—	—	—	—	—	—	—	—	—	16.9	11.53
Apr.	17.9	12.50	16.7	12.53	16.6	12.52	15 8	12.51	14.3	12 59	14.0	12.52	20.7	12.37
May	21.8	13.43	20.8	13.51	20.3	13.49	19.9	13.48	19.4	14.03	19.1	13.53	24.1	13.17
June	25.3	14.16	25.2	14.26	24.8	14.24	23.9	14 24	22.7	14.44	23.0	14.31	26.6	13.40
July	28.4	14.12	28.5	14.22	27.0	14.20	26 8	14.19	25.7	14.50	26.5	14.26	28.2	13.37
Aug.	30.0	13.35	31.1	13.42	29.7	13.41	29.0	13.39	29.1	13.53	28.6	13.43	—	—
Sept.	26.6	13.30	26.8	12.40	25.8	12.42	24.9	12.41	24.4	12.47	24 3	12.39	—	—
Oct.	21.4	11.40	19.4	11.37	20 5	12.38	19.7	11.39	18.6	11.34	18.0	11.32	—	—

Table 7. Reversible Change of Heading Character, Early or Late, According to Cultural Regions, Taiwan and Japan.

1913

Varieties	Taihoku, Taiwan			Shizuoka, Japan		
	Tekougho-ele, 1 st crop var.	Okhak, 1 st crop var.	Nakamura Jap. var.	Tekongho-ele, 1 st crop var.	Okhak, 1 st crop var.	Nakamura Jap. var.
Date of transplating	Mar. 18	Mar. 18	Mar. 18	June 20	June 20	June 20
Temperature °C	17.2	17.2	17.2	23.0	23.0	23.0
Day-length, hours minutes	22 th 12.09	12.09	〃 12.09	14.31	14.31	14.31
Dates of heading	May 30	June 4	May 22	Aug. 17	Aug. 19	Aug. 31
Temperature	24.2	25.0	24.2	26.0	26.0	27.2
Day-length	31 th 13.35	〃 13.35	21 th 12.52	19 th 13.24	13.24	29 th 13.03
Dates of ripening	July 1	July 8	June 24	Oct. 2	Oct. 4	Oct. 21
Temperature	27.5	27.5	27.3	19.4	19.4	16.4
Day-length	June 30 13.41	10 th 13.37	13.42	Sept. 28 11.59	8 th 11.35	18 th 11.59
Days of growth period	73	78	65	58	60	72
Days of ripening period	31	34	33	46	44	51
Total days	104	112	98	104	104	123
	Month decade	Temper-ature	Day length	Month decade	Temper-ature	Day-length
Temperature and day-length of Cultural Period	Mar. 2 nd	17.2	12 th 11.53	1 st	21.6	10 th 14.27
	last	21.0	22 〃 12.09	June 2nd	21.0	20 〃 14.31
	1 st	19.3	1 〃 12.23	last	23.0	30 〃 14.29
	Apr. 2nd	22.5	11 〃 12.37	1 st	25.9	10 〃 14.23
	last	25.3	21 〃 12.52	July 2nd	25.8	20 〃 14.13
	1 st	22.0	1 〃 12.64	last	25.6	30 〃 13.59
	May 2nd	25.6	11 〃 13.17	1 st	27.4	9 〃 13.42
	last	24.2	21 〃 13.27	Aug. 2nd	26.0	19 〃 13.24
	1 st	25.0	10 〃 13.30	last	27.2	29 〃 13.03
	June 2nd	26.8	20 〃 13.42	1 st	26.0	8 〃 12.42
	last	27.3	30 〃 13.41	Sept. 2nd	24.5	18 〃 12.21
	1 st	27.5	10 〃 13.37	last	20.8	28 〃 11.59
	July 2nd	27.3	20 〃 13.30	1 st	19.4	8 〃 11.35
	last	28.3	30 〃 13.20	Oct. 2nd	17.5	18 〃 11.16
				last	16.4	28 〃 10.55

2. 1933

Dates of Sowing (No transplanting)		Temperature °C (mean, month)		Day-lengths (hours, minutes)		Asahi, Japanese Variety					Taichu No. 65, Horai Variety				
						Dates of heading		Days of Vegetative growth			Dates of heading		Days of Vegetative growth		
Taichu	Osaka	Taichu	Osaka	Taichu	Osaka	Taichu	Osaka	Taichu	Osaka	difference	Taichu	Osaka	Taichu	Osaka	difference
Jan. 15		15.7	4.2	10.49	10.00	May 3		108		+19	May 11		116		+ 5
Mar. 15		18.1	7.5	11.54	11.47	May 21		67		+60	May 29		75		+46
May 15	May 17	25.0	17.7	13.13	13.51	July 22	Sept. 21	68	127	+59	July 28	Sept. 15	74	121	+47
		June 26.7	21.9	13.25	14.54										
July 15		27.6	26.2	13.33	14.22	Sept. 10		57		+70	Sept. 18		65		+56
Sept. 15		26.3	23.4	12.29	12.32	Nov. 10		56		+71	Dec. 18		104		+17
Nov. 15		19.7	11.6	11.09	10.37	Apr. 26		162		−35	Apr. 25		171		+50

1 & 2

Varieties	Days of Vegetative growth					Remarks
	Taihoku	Taichu		Osaka	Shizuoka	
	1st crop	1st crop	2nd crop			
Tekonghoele Nat. var. 1st Crop	73	—	—	—	58	Earlier variety in Shizuoka, and later variety in Taihoku than Nakamura.
Okak, Nat. var. 1st Crop	78	—	—	—	60	〃
Asahi, Jap. var.		108 67	57	127	—	Later variety in Osaka and earlier variety in Taichu, than Taichu No. 65.
Nakamura Jap. var.	65	—	—	—	79	Later variety in Shizuoka and earlier variety in Taihoku than Tekonghoele and Okhak.
Taichu No. 65 Horai var.		116 75	65	121	—	Earlier variety in Osaka, and later variety in Taichu than Asahi.

Table 8. Variation of the Characters of the Rice according to the Planting Seasons (Taihoku, 1932)

1.

Variation of days of Vegetative Growth according to the Planting Seasons

Varieties. Group No.	Dates of Sowing (No transplanting)							
	Jan. 16	Feb. 13	Mar. 13	Apr. 10	May 8	June 5	July 3	July 31	Aug. 28
Gonugchut. 2.	248	223	191	166	—	119	96	81	× 79
Ngibe, 4.	136	120	97	76	—	69	67	69	× 79
Toyokuni, 3.	126	116	90	72	70	67	65	63	× 75
Tosa shinriki, 1.	127	103	73	60	78	65	54	47	× 43
Tangochuto, 1.	126	× 101	× 79	×× 71	× 94	78	61	47	×× 45
Iwata asahi, 1.	× 128	× 107	×× 88	× 114	98	80	68	52	×× 50
Kagi Ban No. 2, 1.	× 141	××131	××118	× 124	100	86	79	67	× 64

Remark:- ×, non-uniform heaing. ××, very non-uniform heading.

2.

Variations of Growing Velocity according to the Planting Seasons.

Varieties, Group No.	Dates of Sowing (No transplanting)								
	Jan. 16	Feb. 13	Mar. 13	Apr. 10	May 8	June 5	July 3	July 31	Aug. 28
Gonug chut, 2	10 1	9.3	8.4	7.6	—	5.6	4.8	4.5	5.0
Ngibe, 4	8.3	7.3	6.2	5.4	—	4 6	4.4	4.5	5.3
Toyokuni, 3	8.7	7.3	6.1	5.1	4.7	4.4	4.3	4.2	5.2
Tosa shinriki, 1	8.7	7.4	5 6	5.0	4.8	4.6	4.0	3.7	3.9
Tango chuto, 1	8.5	7.3	6.1	5 4	5.5	4.8	4.0	3 9	4.2
Iwata asahi, 1	8.3	7.1	6.4	6.6	5.4	4.7	4.0	3.8	4.1
Kagi Ban No. 2, 1	8.8	8.1	7.4	6.7	5.7	5.1	4.6	4.5	5.0

Remarks: Growing Velocity—Shown by average days for producing one leaf on the main culm, that is, average days for increasing one node on the main culm.

3.

Variations of Number of Nodes according to the Planting Seasons

Varieties, Group No.	Dates of Sowing (No transplanting)								
	Jan. 16	Feb. 13	Mar. 13	Apr. 10	May 3	June 5	July 3	July 31	Aug 28
Gonug chut 2	24.5	24.0	22.7	22.0	—	21.1	20.0	18.0	15.8
Ngibe, 4	16.4	16.4	15.6	14.1	—	14 8	15.0	15.5	15.0
Toyokuni, 3	14.5	15.9	14.8	14.1	15.1	15.3	15.2	15.2	14.5
Tosashinriki, 1	14.6	14.0	13.0	12.0	16.2	14.1	13.5	12.6	10.9
Tango chuto, 1	14.8	13.8	13.0	13.1	17.1	16.3	15.2	12.2	10.8
Iwata asahi, 1	15.5	15.1	13.8	17.2	18.0	17.1	16.5	13.7	11.3
Kagi Ban No. 2, 1	16.0	16.2	15.9	18.5	17.7	17.0	17.0	15.0	12.8

Note:-

1. Variations of growing speed owing to plantation season:-Average number of days necessary for increasing one leaf in the main stem is greatly controlled by temperature. In the order from January-16-sown to July-31-sown, the number gradually decreases and in the case of August-sown it slightly increases.

2. Variations of the number of nodes owing to plantation season:-In variety group No. 1 the variations of the number of nodes owing to season are remarkable. In such cases as *Tosashinriki* (early variety) and *Tangochuto* sown in May, *Iwataasahi* (late) and *Kagi Ban* No. 2 sown in April, the number of nodes increases rapidly and afterwards until October it rapidly decreases. It is recognized that this is because in the varieties sown in April and May, the formation period of ears corresponds to the season of long day-length and therefore the formation is controlled. On the other hand when the seeds are sown after that, as the formation period of ears corresponds with the season of short day-length, the formation is prompted and the number of nodes remarkably decreases. In the variety groups No. 2 and No. 4 through each sowing period the variations of the number of nodes are not conspicuous.

3. Variations of growing days owing to plantation season:- The number of growing days as a synthetic result of the growing speed and the number of nodes according to temperature and day-length. In No. 2 and No. 4 variety groups, the number of growing days is parallel to the variations of growing speed, is greatly influenced by temperature, and decreases in the order from January-sown to July-sown. Variety group 1 is especially influenced by day-length as well as temperature. In *Tosashinriki* (early variety) and *Tangochuto*, the growing days decrease orderly in the cases from January-sown to April-sown. In the May-sown they again decrease and after that they rapidly decrease. In late varieties as *Iwataasahi* and *Kagi Ban* No. 2 they decrease in the April-sown.

Concerning the intermediate increase of growing days in *Gonug-Chut* (the latest) it is not seen in this table. It is sown in October. When sown in the beginning of October, the plant heads in April or May of next year; when the seeds are sown in the middle or at the end of October, the heading period is September in next year.

4. Variety-group 1 shows a remarkable non-uniformity of heading before the period to increase nodes in April and May. This phenomenon is due to the fact that the action to control heading by long day-length works partially to each tiller separately. Also after August-sown heading becomes non-uniform. This phenomenon expands its degree of non-uniformity by being prompted partially by short day-length as well as by low temperature.

5. In variety-group 1 variations of length of culms and length of leaves owing to season are remarkable. Especially in the second crop, when the plant is planted late, the length of culm and the number of nodes become remarkably short and less.

6. In variety-groups 2 and 4, lengths of lower nodes are long and it is easy to lodge by the breakdown of nodes. But in variety-group 1, lengths of nodes are very short, a resisting power against pressure from outside is strong, it is hard to lodge. Even if the plant falls down, it scarcely does by the breakdown of node, but almost by relavation of root part. In general the correlation coefficient between length of culm and length of ear is considerably high, but in the first crop planted late, it becomes remarkably low.

Table 9. Experimental Results according to the Time of Transplanting (Taihoku).

Varities and Dates of transplanting	Yield of rough rice per *tan.* 4 Years	Length of Culm	Number of ears per clump	Dates of Heading	Dates of Complete heading	Dates of Ripening	Average Days from Sowing to heading
Pahkah hoele Native 1st crop variety	*Koku*	*Shaku*		(1907-10)	(1907-10)	(1907-10)	
Feb. 27	1.712	3.65	11	May 23-June 1	May 29-June 6	June 25- 2	184
Mar. 8	1.931	3.67	13	May 23-June 3	June 4- „ 7	„ 27- 2	175
„ 18	1.995	3.77	13	June 3-5	„ 8- „16	„ 28- 5	167
„ 28	2.077	3.87	13	„ 4-9	„ 9- „17	„ 30- 7	160
Apr. 6	—	3.18	11	„ 9	„18	„ 15	155
„ 16	—	3.26	10	„ 15	„23	„ 20	150
Edo, Japanese variety				(1911-13)	(1911-13)	(1911-13)	
Feb. 26	1.144	2.89	13	May 13-18	May 19-May 23	June 18-21	175
Mar. 8	1.383	2.96	12	„ 14-20	„ 20- „ 25	„ 20-22	166
„ 18	1.520	3.02	13	„ 21-23	„ 26 „ 28	„ 23-27	161
„ 28	1.460	3.10	13	„ 22-25	„ 27-June 2	„ 24-July 2	153
Apr 7	1.425	3.05	11	„ 25-June 1	June 3- „ 8	July 5- 11	153
„ 17	0.737	3.27	13	„ 30-June 20	„ 10	9- 30	—
Keha Native 2nd variety crop				(1908-10)	(1908-10)	(1908-10)	
July 10	1.776	3.51	25	Sept. 20-22	Sept.25-27	Oct. 22-30	146
„ 15	1.828	3.36	23	„ 21-23	„ 27-28	„ 23-31	143
„ 20	1.728	3.43	27	„ 23-24	„ 28-29	„ 24-Nov.2	140

Remark: Days of nursery 60 days in first crop, 40 days in second crop. The experiments before new discovery of culture method of Japanese variety

Table 10. Days of Period of Vegetative Growth according to the Time of Transplanting (Kagi, 1912-13).

Japanese Varieties	Dates of heading				Days of Vegetative growth-period				Length of Culm (*Shaku*)-,upper Number of tillers-under			
	Transplanted				Transplanted				Transplanted			
	Apr. 9	Apr. 11	Apr. 28	May 3	Apr. 9	Apr. 11	Apr. 28	May, 3	Apr. 9	Apr. 11	Apr. 28	May 3
Miyako	July 5	May 25-June 28	Aug. 9-13	Aug. 4	88	79	108	94	2.84 13.0	3.11 20.6	4.05 15.0	4.03 9.3
Nakamura	„	„	„	„	„	„	„	„	3.84 13.6	3.13 2.53	4.54 12.0	4.17 9.4
Edo	„	„	„	„	„	„	„	„	3.08 13.2	2.97 31.6	4.48 14.0	4.17 11.8
Sagamansaku	„	„	„	„	„	„	„	„	3.22 15.8	3.06 24.0	4.55 12.0	4.00 9.4
Kinchaku	„	„	„	„	„	„	„	„	3.67 16.4	3.33 16.8	4.48 14.0	4.11 11.4
Days of nursery period	61	37	54	65	61	37	54	65	61	37	54	65

Remarks: The experiment before the discovery of the culture method of Japanese variety.

Crop Season	Yields of Paddy Per *cho* (*koku*)		
	Average	Max.	Min.
1911, First Crop Mar. 6-Sown- Apr. 6 transplanted	32.000	39.000	28.000
1912, First crop Jan. 8-sown, Apr. 9 transplanted	14.566	19.500	0.956
Feb. 19-Sown, May 3 transplanted	29.332	35.000	24.270
Mar. 6-Sown, Apr.2 transplanted 1913, First crop	21.863	31.350	13.070
Jan. 22-Sown, Mar. 16 transplanted	13.290	—	—

Table 11. Yields of Paddy and Days of Vegetative Growth according to the Time of Transplanting (Taichu 1942)

Crop Season Variety	Dates of trans-planting	Yield of Paddy Per 10a kg)	Number of ears per Clump	Number of grains per ear	Dates of heading and its Standard deviation	Days from trans-planting to heading	Time of harvest-ing	Days of total Growth-Period
First Crop Variety Taichu No. 65 Days of nursery Period 40.	Dec. 29	376	13.5	64.6	Apr. 23.7± 3.08	115.7	May 29	151
	Jan. 8	427	13.6	67.4	27.3± 3.36	109.3	June 1	144
	18	416	13.9	63.3	28.0± 2.77	100.0	2	135
	28	414	13.1	67.0	May 1.2± 3.22	93.2	4	127
	Feb. 7	468	12.6	70.7	2.6± 2.23	86.4	4	117
	17	494	12.9	75.2	9.6± 2.17	81.6	10	119
	27	493	12.7	77.7	16.3± 2.15	72.3	23	118
	Mar. 9	451	11.8	75.4	26.4± 2.52	78.4	July 3	116
	19	402	10.1	80.8	June 1.8± 2.38	74.8	12	115
	29	265	8.9	73.5	8.2± 6.74	71.2	24	117
	Apr. 8	151	9.2	57.8	13.2±10.44	66.7	Aug. 18	132
	18	101	8.7	50.5	22.1±16.73	65.1	28	132
Second Crop Variety Taichu No. 65 Days of nursery Period 20.	June 20	414	12.1	80.8	Sept. 6.4± 3.03	79.4	Oct. 10	113
	30	406	11.6	80.5	5.3± 3.26	68.2	10	103
	July 10	423	12.7	76.5	9.9± 1.80	62.9	12	95
	20	443	12.3	77.7	14.1± 1.48	57.1	16	89
	30	431	11.4	80.6	23.9± 2.25	56.9	26	89
	Aug. 9	408	11.2	72.1	Oct. 7.0± 2.68	60.0	Nov. 8	92
	19	298	11.8	64.5	18.1± 3.05	61.1	21	93
	29	189	11.7	41.5	31.1± 3.81	64.1	Dec. 6	100
	Sept. 8	112	12.0	20.6	Nov. 11.9± 3.38	65.9	18	102
	18	17	12.5	—	Dec. 2.3± 7.08	76.3	Jan. 4	109

4. Double Cropping Rice.

(1) The Kinds of Double Cropping Methods.

The methods of double crops are divided into three:

1) Common method. This is a common way of culture in regions of favourable irrigations or in such a case that varieties must be chosen though irrigation is not quite favourable.

2) Interplanting method. Seedlings cultured (chiefiy 2nd crop variety) during the growing period of the previous crop (chiefiy lst crop variety) are transplanted between hills of the previous crop. After its harvest, take out the remained stumps and weed. Thus the harvest of two crops is gained. The reasons of this way are different according to regions. (i) To keep safety by early planting in the regions where there is a scarcity of irrigation water at the time of transplanting of 2nd crop and accordingly the transplanting is difficult to be done. (ii) To preserve from decay by early planting in those regions where water is deep in 2nd crop season and accordingly it is feared that seedlings may be rotted. For this method special varieties of strong tillering power are used as *Kimkan, Toapehm* in Taiwan.

3) Mixed planting method. Mix early variety (chiefly, lst crop variety) with late variety (chiefly 2nd crop variety) and sow them. The seedlings cultured in this way are transplanted. Then as at the time to harvest early variety, late variety is still growing as young stalks in stumps, the second harvest is able to be gained if late variety is kept carefully.

Interplanting and mixed planting methods are customs unconsciously developed. It can be said that the above-mentioned sensibilities to light and temperature are skilfully made use of in practice,

(2) Regions of Double Crops of the Rice.

Their northern boundary is 16.6% of the whole planted area in Kochi Prefecture in Japan. The following regions are also double-cropping regions: a part of Oshima, Kagoshima Prefecture, 25% of the whole planted area in Ryukyu, 70.5% of the whole planted area in Taiwan, many regions in China, that is, the southern half of Fukien Prov. Kwantung Prov., about one third of Kwangsi Prov, along Kwantung Prov. Moreover, interplanting and mixed

planting are being done in these regions: the northern border of both Fukien and Kwangtung Prov., some parts of Fukien and Kiangsi Prov., the southern bank of the Yangtze River, apart of Hupeh Prov., the northern quarter of Hunan Prov., the northern half of Kiangsi Prov., the banks of Chekiang, region from northeast to southwest along the outside of the locality of the common way in Kwangsi Prov. (BUCK, 1929—33), and it is now developing from 1937 on some parts of the basin of Szechwan where the autumn rain is preserved in the fields for the next rice crop. Through India, Burma or French Indo-China (in Tongking and Annam double crop fields of rice are 32.3% of the whole rice fields in average, vide HENRY, 1922), or in a part of the Philippines double crops of the rice a year are cultured.

Of course, in other places, if irrigation and drainage are favorable, double crop planting is seen locally. Generally in southern tropical regions, if irrigation is favourable double crops ought to be cultured as far as day-length and temperature are concerned. However, not only there are hardly equipments for irrigation, but also distribution of rain is partial, the difference between dry and rainy seasons is large. In rainy season heavy rain and flood of rivers, stagnation of flooded water make culture of double crops impossible, and moreover there is a vast area where normal intensive cultivation is difficult to be done. A big zone of the rice planting of Cambodia and Cochinchina on the basins of the Mekong and Bassac rivers is a good example. So is a big zone of the rice planting of the Bangkok plain on the basin of the McNam River and Lower Burma on the basin of the River Irrawaddy. Even in the Tongking plain on the basin of the Red River where double crops are cultured, this kind of area is very vast. The irrigated area in the Philippines is 516,100 *ha*. Though the area under public and private management is uncertain, the field under the national management is 81,600 *ha* in which 46,000 *ha* is the area of two crops by the irrigation during the dry season. On the Luzon plain irrigated area is 58,518 *ha*, in which 33,800 *ha* has the possibility of double cropping by irrigation during the dry season. And while native variety in the dry season needs growing days of 130-167 days and

produces the paddy harvest 30-60 *cavans* (1 *cavan*=75 l) per *ha.*, in the case of *Taichu* No. 65 the growing days are 125 producing 35-125 *cavans.* Then this variety is recognized as one of the standard varieties in the whole island.

The former customary double-cropping has been almost by the native varieties which belong to *Indica* type. The varieties of the 2nd crop have the seasonal characteristics of the 2nd crop or the special characteristics of both crops. Perhaps it is because rough native varieties which are proof against disease as well as dry weather and fit for extensive culture, are suited for meteorological environment and customary way of planting. In Taiwan intensive double-cropping of *Horai* varieties, *Japonica*-type, has been settled theoretically and economically. Superiority of the *Horai* varieties has been proved in the 2nd crop as well as in the lst crop and it is now spreading even to the Philippines. This success is nothing but a fruit of the research of such a culturing method, that has the possibility to make use of a new hereditary combination of sensibilities to light and temperature and to make use of their response in growing.

5. The So-called Locally Good Variety.

Really the so-called good variety which is widely spread and planted in each region is this: various conditions of each natural environment and farmers' level of technic in culturing ought to be taken into account, and of course economical conditions should be added and then it is complicated and relative. Therefore though an excellent variety has been selected by the principle of the survival of the fittest during a long run of the history of planting in a certain area, that selection has been done under the various conditions of the former natural and artificial environment. Accordingly if these conditions are changed, that excellent variety sometimes cannot be the best.

Therefore, as the artificial conditions progress, favourable natural elements must be more utilized and men must not only get over unfavourable ones,

but also ought to make them better. In respect of sun-light it becomes weaker as latitude gets higher, while becoming stronger as latitude gets lower. Moreover concerning day-length in summer, it becomes longer as latitude gets higher, while getting shorter as latitude becomes low. Day-length in winter is contrary. And in rice-plant, so-called short day plant, there are those varieties which are profitable to be plantd in long-day regions or whose better growth of the vegetation is caused by catching long-day period; or, in some varieties it is more profitable to prompt ripening by short day. Temperature has a similar relation, too. By the utilization of the combination of these (XY) with the progress of the culturing methods, such a variety as has been considered to be impossible to be plantd in a certain area displays a superiority in economic planting, furthermore the cultivation of new areas becomes possible.

The establishment of rice production in the northern high latitude, cold regions—Hokkaido, Khabarovsk, Usuri, Manchuria, Jehol, Chahar Suiyuan owes to the effect of such research and experience on variety-group 3 (**Xs, YS, V**). Generally ecnomic planting of Japanese variety (variety-group 1, (**XS̈, YS, V**) was established in Taiwan where the rice planting was based on the native varieties, *Indica*-type, and a series of new Taiwan varieties called *Horai* varieties (many of them **XS, Ys, v**) was cross-bred and grown, bringing about an epoch-making development of rice production of this island. This is a conspicuous example of the above-mentioned research in these days.

6. A General View of Rice Production in China and Some Considerations on the Varieties of the Rice Plant.

Hsien (籼) is distributed considerably far and wide in the zone of rice in China, especially in the southern part, it is conspicuous, being called *Indica*-type. It is said that varieties in the southern tropical regions almost all belong to *Indica*-type. In contrast with this the Japanese varieties are called *Japonica*-type. This classification has recently been professed (1928) in the

academic circles of Japan. But it has been a short time since this problem was studied. It seems to me there are many questions which require further study.

The Japanese rice-plant is divided into two; "*Uruchi* 粳" (non-glutinous) and "*Mochi* 糯" (glutinous), which are, however, not analogous to "*Hsien* 籼" (non-glutinous), "*Keng* 粳" (non-glutinous) and "*Nuo* 糯" (glutinous). *Hsien* is contrasted to *Keng*. The glutinous rice is usually divided into big and small grains or round and long grains (as in Taiwan) *Hsien* and small-long-glutinous varieties belong to *Indica*-type, while Japanese "*Mochi*" does not include the small-long type.

Taiwan native non-glutinous variety belongs to *Hsien*-group. In the cases of Japanese and *Horai* glutinous varieties, it is customary to add "*Mochi*" to the names of the varieties, "*Chut* 朮" to the native ones. For the convenience of expression and the avoidance of confusion, I temporarily use *Hsien* and *Keng* in contrast to *Nuo* and *Mochi*. It is generally believed that *Indica*-type is more resistant to diseases and drought. Without using any fertilizer, there is still an appropriate amount of harvest. When the fertilizers are sufficiently applied, however, a special increase of harvest cannot be expected. It corresponds to the extensive agriculture in the regions of high temperature. The *Japonica*-type displays its characteristics by intensive-culture method of enough fertilizer, and abundant harvest can be expected. It is inclined to be inferior to some characteristics of *Indica*-type. Japanese rice planting is based on *Japonica*-type, not including *Indica*-type. Chinese rice planting is mostly based on *Indica*-type, *Japonica*-type being added partially. *Japonica*-type is planted fairly far and wide on the basin of the down-stream of the Yangtze, with Kiangsu as its center. The planting areas of *Keng* are as follows (by YANG SHOU-JEN): the whole area of Wuching district, 70-80% of the area for the rice planting in the districts around Wuching, through Kunshan and Wusih, and over Nantung, 30% of Tsingchian, north-west to Nantsung, 10% of Hinghua, 10% of Yencheng, 50% of Yuanyang, south-west to Wusih, 50% of Kintan and Liangyang, 60% of Ihing, 10% of

Hangchow, Chekiang Prov. and such districts as Shaohsing, Yüyao, Ningpo, Choushan, Taichow. Chief producing districts in Kiangsu Prov. are Sungchiang, Soochow, Chanchow, Taitsang, and Chianguing; and those in Chekiang Prov. are Hangchow, Huchow, Shaohsing, Chiahsing, Taichow, Chinhua, Yenchow and Cduchow. Kiangsu rice is of the best quality of Chinese rice. Sungchiang and Soochow are the most famous for it. After all it is *Keng*. Kiangshu rice in the same prefecture is said to be almost comparable with the 2nd or 3rd class of Higo rice in Japan. In Shaohsing in Chekiang Prov. water is fitted for brewage and it is a producer of excellent strong drink. Its raw material called *Kintan* glutinous rice comes from the market in Wusih. In quality Szechwan rice, Chekiang rice, Hunan rice come next to it. Anhwei and Hupeh are inferior to them. About Kiangsu rice once the trader of this district spoke thus: the total amount of *Keng* is about 5,000,000 *koku*, Hsien 16,000,000 *koku*, the total of the two 21,000,000 *koku*. Official stastics is 24, 000,000 *koku*. Therefore the production of *keng* may be estimated more than 5 million *koku*. After all, the production of both Kiangsu and Chekiang Prov. is larger than that of *Horai* rice in Taiwan. But in comparison with the total in China 270,000,000 *Koku*, this is a very small amount. Here one must pay attention to these facts: these producing districts of *Keng* is situated almost on the same latitude as the southern half of Kyushu, Japan. It seems that concerning the sensibilities to light and temperature, the wide-spread varieties belong to the same variety-group as that of Kyushu or the southern districts of the central part of Japan. In fact, the experimental result of *Shinriki*, a Japanese variety, is good in Hangchow. Though I cannot have a chance to visit these districts to observe these facts, the observation on a small number of the varieties of these districts corresponds to my supposition.

In other countries which are situated in the same latitude *i.e* in Valencia and Sueca in Spain, I really observed that because of successful culture of *Shinriki* they imported a large amount of seeds about twenty years ago and also I observed that *Wataribune*, selected variety from *Omachi* and other

Japanese varieties were spread wide in California, U. S. A. As the latitude becomes low, limit-bordering the southern end of Kyushu, the culture of the Japanese varieties belonging to variety-group 1 gets more difficult, if it is done with the former customary technic of culturing, because of meteorological environment, chiefly the relation of day-length. It is necessary to shorten nursery period extremely, as the exprimental results in Taiwan prove. Or as far as *Keng*-varieties are concerned, such varieties as are different from the present Japanese ones in the sensibilities to light and temperature are needed. This is proved quite evident by the results of the planting of new *Horai* varieties in Taiwan and other tropical regions.

Chief producing districts of rice in China are Hwachung (Central China), Szechwan, and Hwanan (South China). The total production of these districts is 2,476,000,000 *koku*, while the total production of China is 2,718,000,000 *koku*. The latitude of these regions is almost midway between the southern extremity of Kyushu, Ryukyu Islands, Taiwan, Hainan and the Tongking plain in French Indo-China. Except Kiangsu and Chekiang Prov. it is said that the *Hsien* is planted for the most part. I have little knowledge of the *Keng* in China. However, the so-called big-round-glutinous variety is planted in various districts. Also in Tongking plain, it is intensively planted in special rich fields. Therefore through the whole area of Chinese rice planting, it may be near to proper that the culture of the varieties of the same type as variety-group 1 should be technically difficult to some degree. I suspect if different types of *Keng*-varieties suitable for each distict, as new *Horai* varieties in Taiwan, are planted, scattering in every small district.

New *Horai* varieties are cross-breds and have shown an excellent result in both crops on level fields of Taiwan in intensive planting. *Taichu* No.65 is now planted making Ryukyu the northern extremity and from the actual results of the planting of *Taichu* No.65, No.150, *Taihoku* No. 7, No. 8, No. 9, No. 10, No. 11, No. 12, No.13, and *Kanan* No. 2, Java may be considered to be the southern extremity. (Yields of white rice per *ha* in local tests:-max. 27.342 *koku*, *Taihoku* No.12, min. 14.805 *koku*, *Taihoku* No.10, all average 20.0886

koku; dates of sowing Nov.15-18, dates of transplanting Dec.5-10, dates of harvesting Mar.20-25,1942). The culture of *Horai* varieties has just commenced the first step and its accomplishment must be expected in the future. But for the necessity of an increased production of food and for the future progress of civilization and intensive agriculture, not only exellent varieties suitable for Japan-or the districts of the same latitude as Japan, but also excellent varieties of different types fitted for every level place of the low latitude may be possible to be cultivated to make great contribution according to the development of planting method.

Table 12. The Recommended Varieties of the Rice Plant in China
After PAN CHIEN-LIANG, Cent. Agr. Expt. Sta. Nanking, China.

Provinces	Recommended Varieties
Hunan	°Wanli hsien. °Hwangchinhsien, °Shenglihsien, °Kangchanhsien °Nan-teh-hao, °Maotzutaw. °Chengnung No. 4.
Kwangsi	°Heitu No. 4, °Paikenuo No. 16, °Tungkuanpai No. 18, °Chunien No. 1, Kuangsitsao ho No. 1. Kwangsitsaoho No. 3, No. 4, No. 5, No. 6, No. 8, Kwangsilaoho No. 1, No. 2, No. 3, No. 4, No. 5, Kwangsiwanho No. 1, No. 2, No. 3, No. 4, No. 5, No. 6, Changannien, yanien, Tawangnien etc 63 Varieties.
Chekiang	°No. 1, °No.8, No. 9, °No. 10, Lungfengchien, °No.129, No. 309, No. 204, No.2038, No. 3586, No. 2687, °No. 2194 No. 302, °No. 3613, Chengnung No, 34
Kwangtung	°Chunien No. 1, °Chinshannien No.18, °Hwanglaochimei No. 1, °Shuyanien No. 2, °Chingkenglan No.4, °Chungshan No. 1.
Szechwan	Nungkaisonien, Chuyaku
Kiangsi	°Kantsao hsien No. 1, °Poyangtsao, °Kanchunghsion No. 11,
Fukien	°No. 2-1, °Changlhsien, "Nan teh-hao, °Hsuanchengtsao
Shansi	Shanhsiangku

Remarks: 1. Following varieties are recommended through 6 Provinces, these are Kiangsi, Honan, Kiangsu, Anhwei, Hupeh and Szechwan (after Ko Hsiang Ien)
Varieties—Chungshan No. 1, Nan teh-hao, Chungnung No. 4, Chukgnung No. 4, Chukgnung No. 34, Shenglihsien, Wanlihsien.
2. Luwanhsien and Che No. 9 are recommended to Szechwan province as the interplanting varieties (after Ko Hsiang Ien)
3. Mark o, showing selected pure line, others are selected by variety test or recognized as good varieties by growers.

Table 13. Temperature, Rainfall, Humidity and Days Free of Frost in the Agricultural Regions of China.

(From BUCK: 1929-33)

I.

	Regions and Areas	Number of Station	Mean Temperature (°C) Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Highest Maximum	Lowest Minimum
Wheat region areas	Spring wheat	9	from −15.1	−13.8	−7.0	5.6	12.8	19.3	21.1	19.9	13.3	4.8	−5.3	−15.2	34.0	−35.0
			to −7.6	−7.8	3.6	11.6	20.0	21.7	23.1	22.6	18.2	9.3	1.7	−3.8	37.5	−21.0
			Mean −11.0						22.5							
	Winter wheat-millet (Sian)		0.8	4.1	10.0	17.1	24.0	28.1	30.0	28.0	22.0	17.0	6.8	2.1	44.0	−12.0
	Winter wheat-Kaoliang	15	−6.1	−3.3	1.4	8.4	13.6	18.3	21.9	21.9	19.4	12.7	3.6	−4.1	31.6	−21.1
			2.9	3.4	9.7	16.3	21.9	27.1	33.0	28.0	23.3	17.9	9.6	4.8	44.0	−9.5
			−1.6						26.2							
Rice region areas	Yangtze Rice-wheat	11	1.8	2.6	6.4	12.0	17.2	21.5	25.2	26.0	21.2	14.9	9.5	1.3	36.0	−22.9
			5.7	7.4	11.5	17.6	22.5	26.8	29.0	29.7	24.8	12.2	13.4	8.0	43.9	−7.0
			3.8						27.9							
	Rice-tea	14	4.7	5.4	8.8	14.6	19.5	23.8	26.2	27.9	21.2	18.9	10.1	4.2	37.2	−10.6
			11.7	10.9	13.5	18.0	22.4	26.8	30.2	29.9	26.6	22.6	17.7	13.1	40.5	−1.7
			5.3						28.5							
	Szechwan-Rice	5	−1.0	2.4	6.9	10.7	14.9	15.9	18.6	17.3	14.9	10.3	6.0	4.4	34.0	−13.0
			9.2	9.9	14.5	17.4	23.1	25.9	28.0	29.1	24.4	19.4	14.8	10.2	43.9	1.0
			7.0						26.5							
	Double Cropping Rice	7	14.1	13.5	15.3	19.4	23.4	27.2	27.8	27.5	27.4	24.2	19.2	14.7	36.1	−0.6
			15.8	14.8	17.4	23.5	27.6	29.2	29.9	29.6	28.5	25.0	20.8	17.0	39.0	6.0
			14.8	14.1					28.9							
	Southwestern Rice	4	2.6	5.9	11.5	15.2	18.0	19.7	21.1	19.6	17.0	12.7	8.7	6.6	28.9	−6.7
			9.1	10.9	15.5	19.9	21.6	25.4	27.3	25.8	21.9	17.5	13.6	10.3	35.4	−3.4
			8.6						21.3							
	Taihoku, Taiwan		15.2	14.8	16.9	20.6	24.1	26.6	28.2	27.9	26.2	23.0	19.8	16.8	36.3	4.8
	Kagoshima, Japan		6.9	7.4	10.7	15.4	18.5	22.4	26.2	26.8	24.2	19.0	13.7	8.9	34.0	3.9
	Tokyo, Japan		3.0	3.8	6.9	12.6	16.7	20.6	24.4	25.7	22.0	16.1	10.7	5.4	34.2	6.1
	From Sowing and transplanting to harvesting		Taihoku: 1st Crop; 2nd Crop													
			Kagoshima:													
			Tokyo:													

II.

Provinces		Cities	Mean Temperatures (°C)											
			Jan.	Feb.	Mar.	Apr.	May.	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Hwachung.	Kiangsu	Shanghai	3.3	4.0	7.8	13.4	18.6	22.9	26.8	26.8	22.7	17.4	11.1	5.6
	Anwei	Wuhu	4.2	4.9	9.1	15.3	20.7	24.9	28.1	28.4	23.9	18.6	12.0	6.2
	Hupeh	Hankow	4.5	5.9	10.2	16.6	21.9	26.5	29.7	29.7	24.8	19.2	12.9	7.0
	Hunan	Changsha	6.1	7.5	10.5	17.0	21.7	26.1	30.2	29.9	25.0	18.9	12.9	6.0
	Kiangsi	Kiukiang	4.7	5.6	10.0	16.7	21.9	26.2	29.8	29.1	25.0	19.2	13.0	7.4
	Chekiang	Hangchow	4.7	5.4	9.1	15.0	24.5	24.5	28.3	27.9	23.2	18.2	11.8	6.0
Szechwan		Chungking	9.2	9.9	14.2	19.7	23.1	25.9	28.0	29.1	24.4	19.4	14.8	10.2
Hwanan	Fukien	Foochow	11.7	10.9	13.5	18.0	22.4	26.8	28.9	29.1	26.6	22.6	17.7	13.1
	Kwangtung	Samshui	14.3	13.6	17.1	21.7	25.6	28.1	28.9	29.3	27.6	24.4	19.2	14.7
	Kwangsi	Nanning	14.4	14.3	18.0	22.8	26.7	29.2	29.9	29.6	28.5	24.9	19.3	14.8

Remark: Shanhai, Wuhu, Hankow, Hangchow—Yangtze Rice-wheat area. Foochow, Kiukiang, Changsha -Rice-tea area. Samshui, Nanning—Double Cropping Rice Area

III.

Regions and Areas	Number of Station		Mean Rainfall by Season of (mm)												Annual Total
			Win.		Spr.			Sum.			Aut.			Win	
			Jan.	Feb.	Mar.	Apr.	May.	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	
Wheat Region Areas															
Spring Wheat	8	from	1	1	3	10	17	38	67	67	28	7	3	2	
		to	5	4	10	23	40	74	212	173	60	22	9	5	
			9		50			235			57				352
Winter Wheat-millet	8	from	2	1	5	8	23	31	83	80	36	11	5	2	
		to	10	8	16	45	57	69	177	128	67	39	11	10	
			15		71			272			73				430
Winter Wheat-kaoliang	32	from	0	0	3	11	2	13	59	71	14	5	0	0	
		to	70	77	58	92	59	158	291	197	139	40	34	60	
			45		81			384			82				592

Rice Region Areas																	
	Yangtze Rice Wheat	18	from	17	17	29	41	43	78	130	49	39	22	7	14		
			to	71	74	104	168	166	323	246	192	147	107	98	63		
				107		258			500			191					1059
	Rice-Tea	11	from	14	36	84	153	150	190	53	63	52	22	34	2		
			to	78	130	210	269	334	321	199	235	225	109	110	60		
				187		498			524			257					1466
	Szechwan-Rice	10	from	5	11	15	47	69	83	70	121	94	47	10	2		
			to	35	35	56	183	172	181	218	246	203	130	75	32		
				47		211			479			237					975
	Double Cropping	17	from	24	33	44	100	154	108	100	129	58	14	1	5		
			to	65	129	153	278	328	456	503	507	273	132	84	55		
				164		335			781			256					1742
	Southwestern Rice	9	from	5	13	14	18	80	129	179	102	105	44	33	3		
			to	25	30	48	85	179	275	294	283	165	159	52	22		
				47		210			657			251					1146

IV

Regions and Areas		Number of Station	Mean relative humidity (%)												
			Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sepl.	Oct.	Nov.	Dec.	Year
Wheat region Areas	Springwheat		—	—	—	—	—	—	—	—	—	—	—	—	—
	Winter wheat millet (Sian)	1	72	69	62	64	64	58	69	79	73	75	76	72	70
	Winter wheat-Kaoliang	7	66	64	61	59	62	68	79	78	69	63	63	64	66
Rice region Areas	Yangtze Rice wheat	8	77	78	77	78	78	81	83	81	79	75	76	76	78
	Rice-tea	6	79	82	82	82	81	83	80	79	80	77	79	78	80
	Szechwan Rice (Chunking)	1	82	81	79	79	79	82	81	80	83	86	84	85	82
	Double Cropping Rice	6	76	80	83	83	82	82	81	81	77	73	73	74	79
	Southwestern Rice	4	65	65	68	72	76	80	86	86	85	82	76	70	76

	Regions and Areas	Number of Localities Studied	Average Number of days free of frost	Number of days Safe free from frost	Days in Growing Season
Wheat Region Areas	Spring wheat	11	from 132	from 113	from 181
			to 184	to 162	to 218
			Mean 151	Mean 131	Mean 196
	Winter wheat-millet (Sian)	13	253	189	231
	Winter wheat-kaoliang	32	187	142	214
			241	219	280
			219	191	241
Rice Region Areas	Yangtze Rice-wheat	29	251	213	216?
			338	270	330
			285	243	293
	Rice-tea	26	289	245	282
			365	365	365
			301	258	308
	Szechwan Ricc	11	365	209	247?
			275?	365	365
			347	324	334
	Double Cropping Rice	17	365	365	365
	Soutwestern Rice	11	260	228	296
			355?	328	365
			300	270?	360

Chapter II. JAPANESE VARIETIES AND THE VARIETIES IN TAIWAN.

1. Origin of the Japansse Varieties and the Japanese Varieties in the Present Age.

Japan is composed of islands which are situated southward from northern high latitude and her planted varieties are limited to the *Japonica*-type (*Uruchi* and big-round-glutinous *Mochi*). Therefore it seems to be important to

find out characteristics of the distributed varieties. When I looked for the original variety of the Japanese rice in classic enquiries, it seems to me that three different races in different eras were independently brought to Japan. The first was *Hyuga* or *Kasasa* variety (the name of a county in the south-western part of Kagoshima Pref.). This was brought in by Tenson or Taka-magahara Race, but its origin was quite questionable. Yet as it was suitable for plains where cultural technic was progressive, it might probably come from such a place that technic of farming was generally advanced after the period of natural planting had passed away in the mythological age. In recent times (1832) NOBUFUCHI SATO wrote about *Hyuga* variety thus: there were four varieties in *Hyuga* rice-plant, *i.e.* white *Uruchi* (non-glutinous), white *Mochi* (glutinous), blue *Uruchi* and blue *Mochi*. Each had weak character, slender culm, small grain, thin chaffs, awnless and the quality of rice was very high.

The second was *Izumo* rice-plant. Before *Hyuga* rice-plant was brought in, it had prosperously been planted in a natural way by *Izumo* race on the banks of shallow marshes and lakes or in muddy dales. In history, it was not clear from where it was brought. According to the words of N.SATO, there were four varieties in *Izumo* rice-plant. They were red *Uruchi*, red *Mochi*, black *Uruchi* and black *Mochi*. Each had strong character, stalk big, grain large, chaffs thick, awned. They grew prosperously even in poor soil.

The third was *Koshi* rice-plant (*Koshi* is an old name of Echigo). It was brought by *Koshi* race before history. This race was different from Ezo, Izumo and Tenson races. It is a question in the history where this race came from. But it is supposed that it came from north Korea, the opposite bank of the Sea of Japan. This variety was also suitable for the natural planting by sowing in muddy hollows of lakes and marshes. SATO said as follows: there were two varieties in this variety, *Nutari Uruchi* and *Nutari Mochi*. These were early varieties called *Muyoka* meaning 68 days, *Nayoka* (78 days) and *Yayoka* (88 days). They could be planted in cold regions where it snowed early or such places as were often drowned. Even today some of the varieties suitable for deep rice-fields among the mountains of Hokuetsu and Dewa, are

recognized to belong to these varieties.

In Japanese rice-plants, there is a variety called *Tau-boshi*. As it was called *Daito*-rice, it was probably transmitted after the communication with Tang (Japanese reading is Tau, the dynasty of Tang in the history of China, Dai means great) had begun in the middle age. It is supposed that the transmitted *Tau-boshi* might belong to the varieties among the South Chinese rice varieties which grow both in common and upland fields. It was planted in Kyushu. The one planted in Hyuga was dark red rice and a little better, that in Satsuma was light red rice, and in quality it was next to the one in *Hyuga*. But in general the quality was not good; when boiled, it expanded. It is written like this: it lacks viscosity; fragrant while it is hot; but when it gets cold, viscosity and fragrance are lost and it makes one feel hungry soon after he takes it. This variety is similar to red rice of Taiwan native variety.

When varieties of the rice-plant were transmitted in old times, conditions to make their plantation possible practically were such that the natural environments, as day-length and temperature, of the new region should be similar to that of the original region. Therefore no matter how historical records are expressed, it is not difficult to suppose the route of transmission. Since then the communication among various races became frequent and by the plantation for thousands of years there gradually grew variations of each variety in mixing, natural hybridizations, segregations and recombinations of the above-mentioned varieties. And as a result of long natural and artificial selection present varieties must have been constructed. But their pedigrees may be divided into three as before and remain in each suitable locality. This is proved by the fact that even now there are differences among the varieties of three provinces as San-in, Kyushu and Hokuriku.

Thus because of the differences of natural and cultural environment, each locality has a different variety. In the South and the central prefectures in Honshu, the variety of the following characters is distributed: in the relation between temperature and day-length inherent minimum days of vegetative growth are generally short, but it is such a variety as is apt to grow satisfactorily by the

prolongation of days of vegetative growth and as is able to head in the suitable period by the combination of day-length with temperature, variety-group 1 (XS, YS, V), including the varieties which have rather intermediate—strong response character to the short day.

In the cold north-eastern provinces, the following kind of variety is spread: the inherent minimum days of vegetative growth are short and it is such that the sensibility to day-length is dull, the heading are strongly prompted by temperature, by their combination it is easy to achieve a satisfactory growth and is able to head in the suitable period.

In general among the earliest varieties in Honshu there are those of these inclinations though the degree is different. It is recognized that the above-mentioned three orginal pedigrees contributed to the construction of the present varieties. But it is supposed that to the former of the present varieties the contribution of Hyuga rice-plant is great while the special characteristics of the latter are greatly due to Koshi rice-plant. It seems that transmitted *Tau-boshi* must probably have belonged to the native lst crop variety-group of Taiwan. I suppose that though its inherent minimnm days of vegetaive growth are long, its heading may easily be prompted by temperature and sensibility to light is dull. But it seems that there was no chance to contribute to the construction of the common varieties which now grow in Japan.

2. Representative Japanese Varieties and the marginal Limits of their Local Distribution.

About 40 years ago there were about one thousand Japanese varieties collected in Kinai Agricultural Experiment Station, Japan, and before that each station in Japan had selected two representive varieties of early, mid -season and late varieties respectively by variety test. Table 14 shows those varieties and the famous varieties of each district at that times.

Table 14. Representative Varieties of Each Locality in Japan.

Regions	Famous Varieties	Agr. Expt. Sta.	Selected Varieties by Agr. Expt. Sta.		
			Early Varieties	Mid-season varieties	Late varieties
Hokkaido	Akage, Bozu, Igoshiwase etc.				
North Oshu	Chikanori, Saikanbozu, Akaine, Nagoyashiro, Hatsukawase etc	Riku-u	Sekiyama Shirakawa,	Yamatochikara, Shinshukaneko,	Oba Sekitori
South Oshu	Sekiyama, Kamenoo, Bungo, Shinshukaneko, Togo ect.	To-o	Hietawase Daikoshine	Bungo. Tsurugi.	Sen-shutsu Yamatonishiki
Hokuriku	Oba, Ishijiro, Hayatakao etc.	Hokuriku	Yasumura Shinshu	Oba. Kyo.	Tokyo-shiragihei Zenkoji
Kanto	Aikoku, Araki, Sekitori, Sugaippon, Shinshu, etc.	Tokyo	Izumo Shinshu	Kinchaku. Araki	Sugaippon Takenari
Tokai	Shinriki, Takenari, Sekitori, Shirozasa, Yamatonishiki	Tokai	Bungo Nabeshima	Shekitori Yaeho	Shimehari Ishiyama-shenbon
San-in	Fukuyama, Kameji, Guneki, Nagaippon etc.	Sanin	Oba Kokoku	Moriwase Guneki	Buzenho Sugaippon
Kinai	Shinriki, Takenari, Omachi, Shiratama, Kokuryomiyako, Yamatonishiki	Kinai	Ipponwase Kinchakubozu	Sanba Okayama-Tengu	Shinriki Takenarisen
Sanyo	Magatama etc.	Sanyo	Tamaga Senbon Fukuyama	Yaehu Omachi	Shinriki Takohomashi
Shikoku	Shinriki, Omochi, Shiratama group,	Shikoku	Yasumura Ishijiro	Sekitori Tanba Izumo	Shinriki Satsuma
Kyushu	Magatama etc.	Kyushu	Wase Shinriki Nippon	Sangoku Shirafuji	Shinriki Takenarisen

Table 15. Prominent Representative -Variety of Each Locality fo Several Divided Parts from the North-east to the South-west and from the Mountainous Region to the Plain.

Regions ——→	Representative Varieties of each Region in Japan					←—— Regions
North / Mountainous region	Akage group	Oba	Aikoku	Takenari	Yamatonishiki	Plain
North / Mountainous region	Saikan group	Ishijiro	Sekitori	Omachi	Shirozasa	Plain
North / Cold region	Sekiyama	Bungo	Afaki	Miyako group	Magatama	South
North / Cold region	Kameno-o	Shinshu	Sugaippon	Shiratama group	Shinriki	Warm region

Table 16. Prominent Bred-Varieties in Japan.

Year (bred)	Varieties	Year (bred)	Varieties	
1848	Sekitori	1893	Kameno-o	
1849	Shiratama	1894	Aikoku	Kokuryo-Miyako, Otoyori,
1852	Miyako	1899	Kinugasawase	Komyonishiki were selected from Miyako.
1860	Isenishiki	1904	Togo	
1861	Oba	1909	Asahi	Asahi was selected from Hinodesen
1869	Omachi	1911	Ginbozu	Wataribune was selected frym Omachi.
1870	Kameji	1919	Bozu No. 5	
1873	Akage	1921	Riku-u No. 132	Togo was selected from Oba
1874	Takenari	1931	Suito-Norin No. 1	
1877	Shinriki			

Table 17. Japanese Varieties which are Planted Widely and Their Local Distributions.

I.

Varieties	Planted Areas (10,000 *Cho*)	Planted provinces and areas in Japan			Marginal boundaries of Culture (Province)		Planted Provinces in Korea
		First Maximum Provinces.	Areas	Next Provinces	North	South	
Shinriki	36.8	Fukuoka	3.3	Kumamoto Chiba	Chiba	Kagoshima	Chuseinando, Chuseihokudo, Keikido, Keishohokudo, Keishonando, Zenranando.
Mii-Shinriki	7.5	Oita	3.2	Miyasaki	Okayama	Kagoshima	
Asahi (旭)	25.5	Aichi Fukuoka	5.1 4.8	Kumamoto	Niigata	Kagoshima	
Aikoku	27.7	Fukushima	5.2	Ibaragi Tochigi Chiba	Akita	Okayama	Kokaido, Heiannando.
Omachi	3.9	Hiroshima Okayama Yamaguchi	0.5 0.5 0.5	Kagoshima	Shiga	Kagoshima	Zenranando.
Miyako	5.3	Yamaguchi	0.3	Hiroshima	Kyoto	Yamaguchi	Keishonando.
Kokuryo Miyako	45.5	Okayama	0.3	Yamaguchi	Hyogo	Yamaguchi	Keishonando, Keishohokudo, Keikido. Zenranando, Zenrahokudo. Kokaido. Kogendo, Kankyonando, Heianhokudo, Heiannando.
Kameno-o	19.9	Aomori	3.3	Akita	Aomori	Niigata	
Toyokuni	4.4	Akita	2.0		Aomori	Yamagata	
Waseono	2.0	Iwate	0.6	Yamagata	Aomori	Yamagata	Kankyohokudo, Kankyonando.
Riku-u No. 123	11.4	Iwate	2.6	Miyagi	Aomori	Nagano	Kokaido, Kogendo.
Ginbozu	15.2	Niigata	4.1	Toyama	Tochigi	Hiroshima	Zenrahokudo, Chuseinando.
Hashiribozu	1.4	Hokkaido	1.4	—	—	—	
Bozu No.2	1.2	Hokkaido	1.2	—	—	—	
Bozu No.5	5.3	Hokkaido	5.3	—	—	—	
Bozu No.6	2.5	Hokkaido	2.5	—	—	—	
Chinkobozu	1.0	Hokkaido	1.0	—	—	—	
Bozu	3.7	Hokkaido	3.7	—	—	—	

Asahi (朝日)	5.7	Hyogo	2.4	Okayama	Hyogo	Okayama	
Kameji	4.4	Okayama	1.3	Shimane	Nagano	Yamaguchi	
Hinode	4.6	Kyoto	0.2	Fukuoka	Kyoto	Fukuoka	Keikido, Kankyonando, Kogendo, Kokaido, Heiannando,
Seekitori	3.6	Gunba	1.3	Nagano	Gunba	Mie	
Oba	3.8	Fukui	1.8	Ishikawa	Niigata	Hyogo	
Benkei	3.2	Hyogo	1.1	Oita	Tottori	Oita	
Seenichi	3.3	Tochigi	2.1	Saitama	Gunma	Saitama	Keikido, Zenranando, Zenrahokudo, Chuseinando, Chuseihokudo, Keishonando, Kokaido, Kogendo.
Tamanishiki	13.9	—	—	—	—		
Sakatawase	1.6	Yamagata	1.0	Niigata	Akita	Niigata	
Igo	2.0	Yamagata	1.1	Akita	Akita	Niigata	
Seekiyama	1.1	Iwate	0.1	Aomri	Aomori	Iwate	Heianhokudo, Kogendo, Chuseinando, Chuseihokuudo,
Chibanishiki	1.3	Ishikawa	1.0	Toyama	Niigata	Ishikawa	
Ishijiro	1.7	Toyama	1.6	—	—	—	Keikido
Chinko	3.2	Fukui	1.7	—	—	—	Kogendo
Kamiyama	1.3	Saga	1.1	Kumamoto	—	—	
Riku-u No.20	1.7	Niigata	1.0	Miyagi	—	—	
Odashiro	1.2	Aomori	0.1	—	—	—	Kankyohokudo.
•Taikyu	1.5	—	—	—	—	—	Heiannando,
•Hakukyoso	0.4	—	—	—	—	—	Heianhokudo
•Seekizanso	1.0	—	—	—	—	—	Zenrahokudo.
•Nenso	0.2	—	—	—	—	—	Heiannando.
	1.1	—	—	—	—	—	Heiannando.
Shintoku	2.1	Saga	2.1	—	—	—	
Kotengu	1.1	Hiroshima	1.1	—	—	—	
Tsunetoyo	1.3	Ibaragi	1.3	—	—	—	
Fusakushirazu	1.3	Saitama	1.3	—	—	—	
•Ryusen	1.2	—	—	—	—	—	Heiannando.
•Eijonteki	1.3	—	—	—	—	—	Heiannando,
Reisuito	0.2	—	—	—	—	—	Heiannando,
Hinodesen	1.6	Okayama	1.6	—	—	—	
Igoshiwase	0.3	Hokkaido	0.2	—	—	—	Kankyohokudo.
(upland rice) Gaisen-mochi	1.2	Kumamoto	0.4	Chiba	Miyagi	Kagoshima	

Remarks: Total number of planted Varieties in the Statistics 1932 was 269 as follows:-

Common Var. Non-glutinous Var. 196, Glutinous Var. 39; Upland var.-non-glutinous Var. 27, glutinous Var. 7.

All total number of planted varieties was estimated about 550.

• - Korean Varieties.

2.

Regions and Provinces	Representative Jap.-Varieties Planted in Korea, including Rep.-Native Varieties.				
North Korea	°Kameno-o (Yamagata, Jap.) H.H., KaN 5.	°Waseono (Yamagata, Jap) Ka.N., KaH. 1.	Eijonteki (Nat.) H.H.	°Sekiyama (Iwate, Jap.) H.H., Ka.N. 1	Ryusen (Nat.) H.N.
Kankyohoku-do (Ka. H.)					
Kankyonan-do (Ka. N)	Hakukyo-so (Nat.) H.H.	Aidachi (Nat.) H.H.	°Odashiro (Aomori, Jap.) Ka.H. 1	Mu-So (Nat.) H.N.	Daikyu and Kurodaikyu (Nat.) H.N.
Heian hoku-do (H. H.)	Baku-So (Nat.) H.H.	Getsu-so (Nat.) H.H.	Sotei-so (Nat.) H.H.	Kyo-So (Nat.) H.H.	Kai-So (Nat.) H.H.
Heian nan-do (H.N.)	°Igoshiwase (Hokkaido, Jap.) Ka.H. 1.				
Central Korea	°KokuryoMiyako (Yamaguchi,Jap.) K.E., C.N., K.K. 43.	°Tamanishiki (Tochigi, Jap.) K.E., C.N., C.H., K.G. 16	°Haya Shinriki (Kumamoto, Jap.) K.E., CN., C.H. 10.	°Nishiki (Niigata. Jap.) C.H., C.N., K.G. 5.	°Chu Shinriki (Yamaguchi,-Jap.) C.N., C.H.
Keiki-do (K.E)					
Kokai-do (K.K.)	°Hinode (Niigata, Jap) K.K., K.G., K.E. 4.	Haku-So (Nat.) K.K., K.E.	Aikoku (Tochigi, Jap.) K.K., K.E.	°Isechinko (1. Jap.) K.G. Coast.	°Sekiyama (Iwate, Jap.) K.G. 1
Chuseihoku-do (C,H.)	Rojin-To (Nat.) K.G.	7-Sho-To (Nat.) K.E., K.G.,	Ryokuto-So (Nat.) K.G.Coast.	Hakusen-So(Nat,) K.E., K.G. a part of North	Rei-To (Nat.) K.K.
Chusei nan-do (C.N.)	°IShijiro (Toyama, Jap.) K.E. 1.	Chu-So (Nat.) K.K.	Tochu (Nat.) North K.G.	Sei-So (Nat.) K.K.	Ojeki (Tokyo,-Jap.) K.G. a part of North
Kogen-do (K.G.)	°Yatsugashira (Jap.) K.K., C.N.	°Oba (Fukui, Jap.) C.H.	Baku-So (Not.) K.E.. K.G.,	Enan-So (Nat.) K.G. apart of north	Bei-So (Nat.) C.H.
South Korea	°Kokuryo Miyako (Yamaguchi, Jap.) 43	°Tamanishiki (Tochigi, Jap.) Z.H., Z.N. 16	°Haya Shinriki (Kumamoto,-Jap.) 10.	°Miyako (Yamaguchi, Jap.) K.S.N. 5.	°Sekizan-So (Nat.) Z.H.
KeishoHoku-do (K. S. N.)					
Keishonan-do (K.S.N.)	°Omachi (Okayama. Jap.) Z.N. 5	°Chujyuku Shinriki (Kinai-Agr. Ept. sta.-Jap.) Z.N.	°Benkei (Yamaguchi, Jap.) Z.N., Z.H., 1.	°Chu Shinriki (Yamaguchi,-Jap.) K.S.N.	Aikoku (Tochigi, Jap.) Z.N. Z.N.
Zenrahoku-do (Z.H.)	Rojin-To (Nat.) K.S.H.	Shukakuretsu (Nat.) Z.H.	°Takachiho (Jap.) Z.N.	Kyoto (Kyoto?-Jap.) Z.H.	Fuzan-To (Kochi, Jap.) K.S.N.
Zenranan-do (Z.N.)	Bei-So (Nat.) Z.H.	Kumano-Modoshi (Hiroshima, Jap.) K.S.N.	To-So (Nat.) Z.H.,K.S.N.	Suzuki Shinriki (Yamanashi or Okayama, Jap.) Z.H.	Gin-Bozu (Toyama, Jap.) Z.H.
	Chu-So (Nat.) Z.N.	Wai-So (Nat.) Z.H.. Z.N., K,S.N.			

Remarks: ° shows officially recommended varieties (1930).

Numbers shows distributed areas in 10000 *Cho* (1930).

( ) showing the origins.

Table 18. A Part of Experimental Results of Above-mentioned Japanese Varieties and Others in Taiwan

Varieties	Dates of Heading (Ist crop)	Days of Vegetative Growth-period	Length of Culm (*cm*)	Number of Tillers	Yield of Paddy per *ha.* (*kg.*)		Remarks.
					1st Crop	2nd Crop	
°Aikawa	June 9	126	119.4	9.8	4410	3285	-had been distributed in one part of Shinchiku Pref.
Aikoku	May 25	111	97.2	7.4	3780	2700	-planted area in the northern and central districts -15,800 *ko*, 1936.
°Akage	„ 18	104	93.2	8.2	478	650	
Araki	„ 26	112	107.2	8.6	3951	2459	
Iwata asahi	June 6	123	94.8	15.9	4027	4159	-escaped the damage by rice-blast disease in 1926. -Taino No. 18=Iwata asahi×Kagi Ban No. 2 -Taino No. 38=Taichu No. 65×Iwata asahi.
Asahi	May 27	113	113.3	11.4	4012	3898	-planted area in the Northern and central districts -20,600 *ko*, 1935. Quality excellent.
Banshirozasa	June 7	124	99.6	8.4	3367	2961	-K2=Chibanishiki×Oita-Benkei,
Benkei	May 26	112	87.5	8.1	3447	2940	K110 (Kwon Fon No. 1)=Taino No. 45×K2 -Taino No. 45=Taino No. 16×Taichu No. 65.
°Bozu	„ 11	97	89.3	8.2	556	953	
°Hashiri bozu	June 9	126	103.3	10.8	3568	3515	
Ginbozu	May 21	107	88.5	10.3	3120	2165	
°Bungo	„ 22	108	104.9	9.9	4210	—	
Chibanishiki	„ 22	108	29.3	12.1	3503	2930	-K2=Chibanishiki×Oita Benkei
Fukuyama	„ 31	117	89.3	11.3	2772	2666	
Guneki	„ 29	115	119.7	8.5	3481	2877	
°Hiratawase	June 2	119	120.4	9.2	3112	2587	
°Hiyoshi	„ 2	119	120.9	8.8	4455	2820	
Homashi	May 27	113	115.4	9.8	3963	2906	
Isenishiki	„ 30	116	96.0	7.8	3998	3789	
Ishijira	June 3	120	94.8	9.7	3226	1344	-Completely escaped the damage by rice-blast disease, 1926.

°Iyosengoku	„	16	125	108.1	9.4	3834	4636	Kagi Bon No. 2—Separated from Iyosengoku. Taino No. 37=Iyosengoku×Tango Chuto Taino No. 16=Shimehari×Kagi Ban No.2.
Izumowase	May	29	115	85.1	8.3	2543	3423	-Taihoku No. 10=Kyonishiki×Kagi Ban No. 2.
Kameji	May	23	109	110.4	9.3	4444	3940	-Taichu No. 65=Kameji× Shinriki.
Kameno-o	June	4	121	108.9	6.8	3642	2957	-had been distributed in one part of Shinchiku Pref.
°Sakaikaneko	„	7	124	124.8	7.7	4118	3258	
Shinshukaneko	May	30	116	88.6	13.5	3006	2526	
Kinchaku	„	29	115	106.6	13.0	4113	—	
Kiryoyoshi	June	5	114	87.5	17.2	3578	3278	
Kinugasawase	May	28	114	107.1	6.6	3271	2602	
°Kyonishiki	„	31	117	108.1	8.5	3488	—	Taihoku No. 6=Kyonishiki×Oska asahi. Taihoku No. 7,8.=Taihoku No. 6×Taihoku No. 5.
Magatama	June	5	122	104.8	8.7	3437	3072	
Meijinishiki	May	31	117	121.2	9.1	3326	2972	-Taihoku No. 5=Meijinishiki×Yokichisen.
Miyako	„	27	113	103.0	9.6	4165	3013	-Taichu Mochi No, 35=(Miyako×Chia thau Gonug-chut)×Taichu Toku No. 6.
Kokuryomiyako	June	8	125	93.1	18.8	4380	3779	
Moriwase	„	7	124	99.5	14.3	3618	3831	
Nabeshima	„	2	119	105.6	13.1	3002	3068	
Nakamura	May	29	115	113.5	12.0	4327	3719	-planted area in 1926 110,000 *ko.* Seriously damaged by rice-blast disease in that year.
Nippon	„	27	113	121.8	9.0	3697	2756	
Oba	„	22	108	90.6	15.3	4054	3498	
Odashiro	June	3	120	130.6	8.0	2571	1793	
Omachi	May	28	114	100.3	8.1	4674	3376	
°Riku-u No. 132	„	27	113	100.2	9.4	3638	2727	-had been distributed in one part of Shinchiku Pref.
Sanba	„	28	114	116.7	9.2	3946	2895	
Satsuma	June	5	122	105.9	10.8	3082	2096	
Sekitori	May	24	110	107.3	7.6	3703	3036	
Sekiyama	„	26	112	104.8	7.5	1815	1202	
Senichi	June	2	119	102.7	8.0	3367	2420	
Shimehari	May	23	119	98.9	12.3	3940	3094	-Taino No. 16=Shimehari×Kagi Ban No.2.

Shinriki	June	20	129	94.6	15.9	4385	3523	-Taichu No. 65==Kameji×Shinriki. -Taichu Toku No. 2=Separated from Shinriki.
Ashigara shinriki		27	113	99.0	15.8	4459	4110	
Sagawa shinriki		27	113	91.1	10.8	4721	4430	
Shinshonai		29	115	114.2	8.4	5201	4280	
Saikanbozu		27	113	112.2	7.0	2641	—	-escaped the damage by rice-brust disease 1926.
Sagamansaku		29	115	112.5	14.0	4210	3714	-planted area in 1927 was 12,800 *ko* in Shinchiku Pref.
Shirafuji		29	115	120.8	9.4	4066	3528	-Qualily is a liltte better than Nakamura.
Shiratama		31	117	106.5	10.0	3935	2728	
Sugaippon		28	114	118.8	9.9	3960	3183	-had been distributed in Kyurin, Chikutogun, Shinchikn Pref. and exported for special use according to its excellent quality, to Tokyo market.
Takenari		28	114	99.6	10.1	4160	3097	-Takao No. 6=Takenari×Kinaichusei No. 76.
Takenarisen		28	114	90.6	17.0	3082	2601	-Taino No. 37=Kagi Ban No. 2×Tangochuto.
Tangochuto		26	112	90.5	13.1	3721	3119	
Togo		24	110	93.2	10.8	—	—	
Tokushima Oizumi		26	112	92.3	15.6	4293	4253	
°Toyokuni		5	122	136.7	7.3	3425	3182	-Taino No. 40, 41, 42.=(Toyokuni×Iwataasahi)× -Taichu No. 65.
°Waseono		21	107	104.9	5.2	3664	2012	
Yamatochikara		30	116	94.1	10.8	2112	2343	
Yasumura		26	112	98.6	9.7	3260	3393	
°Yokichisen		20	129	101.0	8.7	3290	2881	-Completely escaped the damage by rice-blast disease, 1926. -Taihoku No. 3 =Meijinishiki×Yokichisen.

Remarks: Total number of Japanese Varieties experimented is 1259.

°-shows comparatively weak response against short day-length among many Japanese Varieties or near to no-response.

Groups	Crop season	Number of Varieties Used for average	Yield per *ha*	
			Paddy, *kg.*	Rough rice, *koku*
Taiwan Native Varieties 1919	First Crop	140	3157	16.736
	Second Crop	178	3147	16.683
	Intermediate Crop	24	2724	14.440
Japanese Varieties 1924–25	First Crop	178	3407	18.122
	Second Crop	183	2830	14.964
Cross bred *Horai* Varieties and pure Line-Selected Japanese Varieties, 1922–43	First Crop	126	3770	20.039
	Second Crop	126	3429	18.165

Results of Variety test in 1907–12.

Agr. Expt. Sta.	Varieties obtained from (district)	Number of Varieties	Yields of rough rice per *tan* (*koku*)				High Yield Varieties (habitat) in order
			Average	Max.	Min.	Years Averaged	
Taihoku (North)	Taihoku, Giran, Toen, Northern, Shinchiku, Taito, Karenko	Ist Crop 34. Native varities	1.963	2.218	1.598	4	{Pe-khe-hoele (Taihoku), Tekonghoele (〃) Liu-chiu (Kielung), Koainkha-hoele (〃) O-khak (〃)
		15, Japanese Varieties	1.998	2.199	1.665	3	{Nakamura (Japanese variety), Sagamansaku (〃) Shirafuji(〃)Miyako(〃)Kinchaku(〃)
		2nd Crop 43. Nat. Var.	1.704	1.836	1.343	5	{Ban-chheng-iu (Shinchiku), Keha (Taihoku) KoainKha-Keha (〃)
Taichu (Central)	Southern, Shinchiku, Byoritsu, Taichu, Nanto, Northern kagi.	Ist Crop 38. Nat. Var.	1.779	2.228	1.166	3	{chut-a-pian (Toroku), O-Khak (Taichu), Toa-O (Nanto) peh-khak-hoele (Toen) Hoele (Taichu).
		2nd Crop 43. Nat. Var.	1.877	2.295	1.238	3	{Hu-cheng (Taichu), Hoan-a (Toroku), Chian-tah (Taichu), chhong-liu (Toroku)
Ako (South)	Southern Kagi, Tainan, Ako	Ist. Crop 29. Nat. Var.	1.984	2.359	1.145	4	{O-liap (Hozan), O-liap (Ako), Peh-hioh(〃) Tiong-o-Khak (Banshoryo), O-chihm (Ensuiko).
		27, Nat. Var.	1.640	1.930	1.267	4	Chut-pian (Ako), Peh-chut-ku (Hozan) O-chiam (Banshoryo), Toa-Pian (Ako) O-chiam (〃)

3. The Adaptabilities of Japanese Varieties in the Cold Regions of High North Latitude.

(1) Hokkaido varieties.

General characteristics of Hokkaido variety is this: inherent minimum days of vegetative growth are short, sensibility to day-length is weaker than the varieties which are distributed to north-eastern districts in Honshu, sensibility to temperature is higher. Accordingly by the combination of both, though in the very cold regions, day-length in summer is far longer than that in warm land of low latitude; the heading is rapidly prompted by the rise of temperature during the planting period. Thus it becomes possible to plant in northern cold climate regions.

The rice-planting in Primorskaya, Soviet Union is historically very new. According to literature there existed rice-fields early in 1860's.

After that they were quite abandoned and in 1917 the rice-planting began near Grodekowo station. The present territory of rice-planting is the basin of Ussuri River and northwards reaches Khabarovsk. Another planted area is Blagoveshchensk district. The experimental results are good. There is vast room to be developed in the future. And Hokkaido variety is greatly contributing to the rice-planting of these cold climates.

The rice-regions in Manchuria are situated in the same north latitude (40-45°) as Hokkaido and north-eastern districts of Japan as well as the southern part of Primorskaya of Soviet Union and north Korea. *i. e.*

	N. Latitude	Localities at about same Latitude
I-Mienpo	45°01′	
Mutankiag	44°36′	
Chang Chum, Kirin	43°50′	Asahigawa (Hokkaido)
Tiehling, Shanchengtzu	42°20′	Muroran (Hokkaido), Kainei (Korea)
Mukden, Fushan	41°55′	Hakodate (Hokkaido), Kyojyo (Korea)
Liauyang, Hwaijen	41°10′	Aomori (North Japan)
Yingkow, Kwantien	40°45′	Jyosin (Korea)
Hsiungyuehcheng, Antung	40°10′	Niigata, Akita (North Japan)
Dairen	38°50′	Sakata (North Japan)

The rice-planting of Manchuria is very promising for the future, estimation of the area is about one million *cho* (S. M. Rwly. Co.) and there is possibility to put it in practice technically under the same conditions as Hokkaido and the north-eastern districts of Honshu, Japan. And the contribution

of varieties of Hokkaiko and the north-eastern districts to the rice-planting in Manchuria is also great.

The rice-fields in Jehol, Chahar and Suiyuan are chiefly everywhere on the basin of the Liaoho River. They were cultivated about seventy or eighty years ago. But the culturing area has been increased recently. There is an inclination to develop in the future. I will show here chief varieties in each locality in Manchuria and Inner Mongolia.

(2) The experimenlal results of Hokkaido varieties in-Manchuria (Table)

Table 19. Important Varieties in Manchuria

Southern Manchuria ×		Central Monchuria ××		Northern Manchuria ×××	
Varieties	yield of rough rice per *tan* (*koku*)	Varieties	yield of rough rice per *tan* (*koku*)	Varieties	yield of rough rice per *tan* (*koku*)
Kameno-o (Japanese variety)	2.827	Chingchu (Kor. var.)	1.830	Sapporo Akage or Pehhai (Jap. var.)	2.079
Mannen or Wanni-en Jap. var. pure line selection of Kameno-o	2.860	Kinugasa or Chiali (Jap. var.)	2.657	Odashiro or Tien-tai (Jap. var.)	2.561
Waseono (Jap. var.)	2.647	Heichu (Kor. var.)	—	Tsugarujimai or Ching sheng (Jap. var.)	3.220
Taigen (Jap. var.) pure line selection of waseono	3.000	Tsaotingchu (Kor. var.)	—	Tienluochu (Jap. var.)	—
Yasumura (Jap var.)	—	Taikupeh or Tachinchu (Kor. var.)	—	Chosen-mochi (Jap. var.)	—
Shinshukaneko (Jap. var.)	—	Maichu (Kor. var)	—	Mifushi or Sans-etsu-mochi (Jap. var.)	—
Soma (Jap. var.)	—	Chosen-mochi (Kor. var.)	—		
Hung hwang towth (Korean variety)	2.057				
Hung mautze (Kor. var.)	—				
Taikupehor Tochiuchu (Kor. var.)	—				
Chihkanrh (Kor. var.)	—				
Aka-mochi (Jap. var.)	—				
Benkei-mochi (Jap. var.)	—				

Remarks: ×, 8 year's average except Hung wantowrh 7 years, 1921-28, Hsiung yueh-cheng Agr. Expt. Sta.

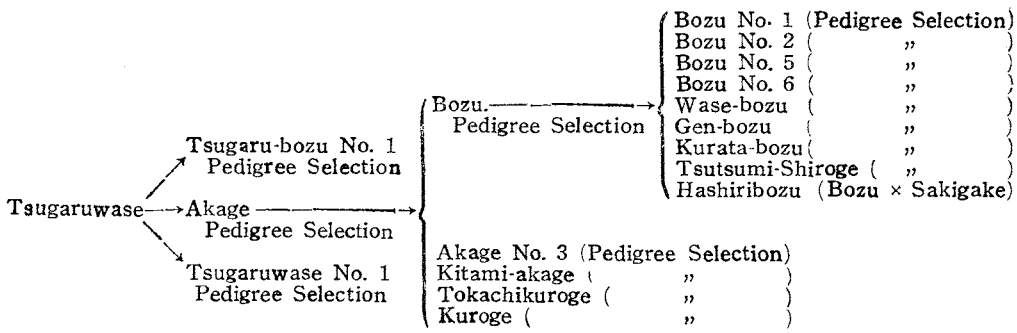
××. 2 year's average, 1928-29, Mukden and Fushan Seed farms.

×××. 7 year's average, 1925-32, Tayushu Seed farm.

As far as the rice-plantation in Hokkaido is concerned, though the origin is old, still its striking development has been done in recent years. It was based on the plantation of such varieties as were suitable fpr the special natural environment of temperature and day-length in the cold region of high latitude and the spread of intensive dibbling culture method by the invention of rectangular sowing implements made the planted area strikingly vast. Accordingly the varieties of the rice-plant are not so numerous as in warm land. There are only scores of varieties. In respect to the non-glutinous rice, there are *Akage* Group (4.9% of planted area) which is separated from *Tsugaruwase* (imported from Aomoriken, Honshu, Japan), *Bozu* separated from *Akage* and moreover *Bozu* group separated from *Bozu* (78.6%). The total area planted by these varieties is 83.5% of the whole area of non-glutinous rice planting. When *Chinkobozu* (5.6%), *Kurobozu* (0.1%) and *Hashiribozu* (*Bozu* x *Sakigake*) are added to these, it amounts to 90%. The origins of *Chinkobozu* and *Kurobozu* are not clear. Most of the varieties except *Tsugarubozu* No. 1 and *Tsugaruwase* No. 1 which are separated from *Tsugaruwase* are planted in the central part of Hokkaido as early or early-late variety. *Hashiribozu* is the earliest and *Kitamiakage*, *Kurobozu* and *Kuroge* are fitted as early varieties. Moreover there may be those varieties which belong to this group though their history and origin are obscure. *Akage* and *Bozu* groups are the most important of the present Hokkaido rice-plant, and *Tsugaruwase* may be recognized as a great origin.

Most of other varieties except *Sapporoshiroge*, *Datebozu*, *Sakigake*—those origin is not clear—and *Nakazawashiroge*, are fitted for the comparatively warm regions in the southern part of Hokkaido. The rate of these varieties to the whole area of non-glutinous varieties is small.

Table 20. Varieties in Hokkaido


Tsugaruwase
Tsugaru-bozu No. 1 Pedigree Selection
Akage Pedigree Selection
Tsugaruwase No. 1 Pedigree Selection
Bozu. Pedigree Selection
Bozu No. 1 (Pedigree Selection)
Bozu No. 2 („)
Bozu No. 5 („)
Bozu No. 6 („)
Wase-bozu („)
Gen-bozu („)
Kurata-bozu („)
Tsutsumi-Shiroge („)
Hashiribozu (Bozu × Sakigake)
Akage No. 3 (Pedigree Selection)
Kitami-akage („)
Tokachikuroge („)
Kuroge („)

Other Varieties:

Sapporo shiroge (Ancestor unknown), Chinko-bozu (〃), Date-bozu (〃), Sakigake (〃), Nakazawa-Shiroge (Pedigree selection of Inari-mochi), Kuro-bozu (Ancestor unknown)—All these vavieties are planted in the Central Part of Hokkaido. Iburiwase (Ancestor unknown), Nozaki (Pedigree Selection of Shiroge-tsugaruwase which was imported from Aomori Prefecture), Shiroge (Ancestor unknown), Jimai (imported from Aomori pref.), Matsudawase (Pedigree selection of Jimai), Sekaiichi (〃), Chikanari (imported from Aomori pref.), Sawadamai (Pedigree selection of Chikanari , Date-Chikanari (Ancestor unknown), Kintoki (〃), Chusei-Shiroge (〃), Mantaromai (〃), Kinokojimai (〃), Igoshiwase (Natural cross among mixed planting of 13 varieties, such as Sapporowase, Tomai, Sandokawara, Jimai, Tsugarumai, Akitamai, Akashitsuto, Shiroshitsuto, Akitasaikan, Fuzukijimai, Reisui, Chikanari and Akamari.

Varieties recommended officially in Hokkaido:

1. In general,
   Bozu, Akage, Akage No. 3, Bozu No. 1. Bozu No. 2.
2. Comparatively warm regions, the South.
   Igoshiwase, Tsugaruwase, Tsugaru-bozu No. 1, Matsudawase, Shiroge.
2. Cold regions.
   Bozu No 6, Sakigake, Kuroge, Tokachi-kuroge.

Comparatively good glutinous varieties:

1. Comparatively warm region, Hiyama district.
   Oshima-mochi (Ancestor unknown).
2. Cold regions, Sapporo, Sorachi, Tokachi districts.
   Atsubetsu-mochi (Ancestor unknown), Kairyo-mochi (Pedigree selection of Atsubetsu-mochi), Shimada-mochi (Pedigree selection of Akage), Okada-mochi, Tamura-mochi, Ono-mochi, Yamasaki-mochi, Akage-mochi—these five varieties are pedigree selections of Shimada-mochi.
3. Other Varieties.
   Kurigara-mochi, Kuro-mochi, Terabayashi-mochi,—these three varieties are pedigree selections of Bozu., Fukuda-mochi (Pedigree selection of Date-Bozu), Kuroge-mochi (Ancestor unknown), Suzuki-mochi (〃).

Table 21. Yields of Rough rice per *tan* in Experiments of Hokkaido Varieties in Manchuria and Hokkaido (*koku*)

1.

Dates of transplanting		Hokkaido							Manchuria	
		Asahi-gawa	Sapporo	Tokachi	Kitami	Oshima			Chang chum	Hsiung yueh cheng
		Akage var.	Akage var.	Kuroge var.	Akage var.	Akage var.	Jimai var.	Tsugaru-wase var	Sapporo Akage var.	Waseono var.
		1905-7 3 years average	1903-8 6 years average	1914-17 4 years average	1912-16 5 years average	1910-13 4 years average	〃	〃	1915-18 4 years average	1913-17 5 years average
June	1	—	—	—	—	2.066	2.061	—	—	—
〃	5	—	—	—	—	2.079	2.106	2.379	—	2.359
〃	10	2.402	1.786	1.650	1.401	2.093	2.276	2.356	2.559	2.359
〃	15	—	1.679	—	—	2.123	2.091	2.419	2.372	2.055
〃	20	2.029	1.352	1.501	1.262	2.077	1.839	2.361	2.157	2.112
〃	25	—	0.924	—	1.052	—	—	2.487	1.992	1.993
〃	30	1.778	0 539	1.304	—	—	—	—	2.082	—
July	15	1.188	—	—	—	—	—	—	—	—

Remarks: Proper season of transplanting. It is safe to be transplanted until the middle of June; 10th in the comparatively warm part, such as Oshima and Hsiung yueh Cheng; 15th in other parts.

Waseono is a variety of northern Honshu, Japan.

2.

Dates of Sowing (No transplanting)		Hokkaido					Manchuria	
		Asahi-gawa	Sapporo	Iburi	Hidaka	Tokachi	Chang-chum	Hsiung yueh Cheng
		Akage var.	Akage var.	Akage var.	Bozu No. 5 var.	Kuroge var.	Akage var.	Waseono var
		1905-7 3 years average	1905-7 3 years average	1917-22 6 years average	1919-22 4 years average	1912-17 4 years average	1914-18 5 years average	1914-17 4 years average
Apr.	20	—	—	—	—	—	—	2.803
»	30	—	—	—	—	—	—	2.609
May	5	—	—	—	—	—	2.667	—
»	10	2.270	—	—	1.881	1.809	2.891	2.483
»	15	—	1.728	—	2.024	—	2.799	—
»	20	2.184	—	1.878	2.379	1.654	2.986	2.345
»	25	—	1.484	1.796	2.347	—	2.809	—
»	30	1.933	1.165	1.706	2.366	1.611	2.600	2.188
June	5	—	—	—	1.915	—	2.623	—
»	10	1.465	1.069	—	1.689	—	—	—
»	20	0.542	—	—	—	—	—	—
»	30	0.288	—	—	—	—	—	—

Remarks: Proper season of sowing. It is safe to be sown until the middle of May, 10th of May in general; 2-3 weeks earlier in comparatively warm parts, such as Hsiung yueh cheng.

3.

Important Varieties in Manchuria

Adapted Regions	Varieties	Origin	Average Yield of rough rice per ha (kg.)	Remarks
Officially recommended South	Kameno-o	Yamagata, Jap.	Hsiung Yueh Cheng Agr. Expt. Sta. 4,590 (7)	Mid-season Var. heads Aug. begining ripes Sept. end-Oct., beginning
»	Mannen	Hsiung Yueh Cheng Agr. Expt. Sta. Pure Line Selection from Kameno-o (P.L. Sel.)	4,915 (5)	»
»	Taigon	P.L. Sel. Waseono	5,087 (5)	Late Var, heads Aug. middle, ripens Oct. beginning
»	Rikuu No. 133	Rikuu Agr, Expt. Sta. Jap. Aikoku × Kameno-o	4,732 (5)	Mid-season Var.
»	Aka-mochi or Hung-mochi	Yamagata, Jap.	4,204 (6)	Late Var.
South & Central	Kameno-o No. 3	»	Fushan Seed farm 4,050 (2)	Early-Late Var.

Adapted Region	Varieties	Origin	Average yield of rough rice per *ha* (kg.)	Remarks
Central	Chiali or Kinugasa wase	Kochi, Jap.	4,070 (6)	Second Crop Var. in Kochi, Jap.
"	Chin Chu	Korea	3,232 (6)	
Central & North	Tientai or Odashiro	Aomori, Jap.	Tanyushu Seed farm 4,565 (5)	
North	Ching Cheng or Tsugaru-jishu	"	4,387 (5)	
	Peh-hai or Sapporo Akage	Hokkaido, Jap.	3,525 (5)	
General			Hsiung Yueh Cheng Agr. Expt. Sta.	Early Var., heads July end-Aug end
South	Waseono	Yamagata, Jap.	4,401 (7)	ripens Sept. end
"	Norin No. 1	Niigata Agr. Expt. Sta. Sel. (Moriwase × Rikuu No. 132)Rikuu Agr. Expt. Sta. Jap.	5,453 (2)	"
"	Kairyo Aikoku or Kinai-So No. 22	Kinai Agr. Expt. Sta. Jap. Shinshu Kaneko X Aikoku	5,254 (5)	Late Var.
"	Hungkwang-towrh	Korea?	3,082 (7)	Early-Late Var.
"	Hungmautze	"	4,215 (6)	
"	Kawabe-mochi	Niigata or Yamagta? Jap.	4,215 (6)	Late Var.
"	Kawabe-mochi No. 4	Niigataor Yamagata? Jap. P. L. Sel. Kawabe-mochi		Early-Late Var.
"	Benkei-mochi	Nagano, Jap.	4,852 (2)	Late Var.
"	Yasumura	Saitama, Jap.	4,103 (2)	
"	Shinshu Kaneko	Ibaragi, Jap.		
"	Chihkanrh	Korea		
"	Soma	? Jap		
"	Rikuu No. 123	Rikuu. Agr. Expt. Sta. Jap.	3,897 (2)	
"	" No. 140	"	4,228 (2)	
"	" No. 127	"	4 323 (2)	
"	" No. 136	"	4,101 (2)	
"	Oba	Fukui, Jap.	3,259 (4)	Tang Kung tze alkalien soil Expt. field
"	Chusei-Aikoku	Yamagata, Jap.	4,065 (3)	
"	Waseono No. 109	Iwate. Jap.	4,084 (3)	
South & Central	Akita No. 1	Akita Agr. Expl. Sta. Jap. Waseaikoku × Waseono		Early Var. in Hsiuug Yueh Cheng Early-Late Var.in Fushan.

Adapted Regions	Varieties	Origin	Average yield of rough rice per *ha* (kg.)	Remarks
〃	Tachiuchu	Korea.		
〃	Iwatewaseono	Iwate, Jap		
〃	Shinono	〃 Jap.		
Central	Toyokuni No. 3	Aomori Agr. Expt. Sta. Jap. P.L. Sel. Toyokuni	Fushan Seed farm 3,723 (2)	Early-Late Var.
〃	Ou No. 12	Rikuu Agr. Expt. Sta. Jap. Sekiyama × Kameno-o		Midseason Var.
〃	Heichu	Korea?	Mukden Seed farm 2,938 (4)	
〃	Tsotingchu	〃		
〃	Maichu	Korea		
〃	Akawase	? Jap.	2,954 (4)	
〃	Nobutomowase	? Jap.	Fushan Seed farm 3,896 (2)	Early-Late Var.
Central & North	Odashiro No. 1	Aomori, Jap.	4,782 (4)	
〃	Chosen-mochi	Korea	Chang Chun Expt field 3,324 (5)	
〃	Igoshi-mochi	Hokkaido Jap.	2,652 (5)	
North	Tienluochu	Korea	4,264 (4)	Late Var. in Tunhwa
〃	Bozu	Hokkaido Jap.		
〃	Bozu No. 1, 2, 5, 6,	Hokkaido Agr. Expt. Sta. Jap. P.L. Sel. Bozu		
〃	Akage	Hokkaido Jap.		
〃	Igoshiwase No. 3	〃	Changchun Expt. field 3,614 (5)	
〃	Mifushi-mochi	? Jap.		
〃	Tokachikuroge	Hokkaido Agr. Expt. Sta. Jap. P.L. Sel. Akage	Tunhwa Seed farm 2,467 (3)	
〃	Hashiri Bozu	Bozu × Sakigake	2,266 (4)	

Remarks: 1. Estimated average yield of rough rice per *tan* in general

Southern region 1.5-2.0 *koku*

Central region 1.5-2.0 〃

Northern region 1.25-1.5 〃

2. Paddy, 1 *koku*=96kg

Rough rice, 1 *koku*=143-148kg

1 *ha*=1.25 *cho*=12.5 *tan*

3. Number in ( ), Number of years used for average

Table 22. Day-Lengths and Temperatures of Hokkaido and the First-Crop Season of Taiwan

	Sapporo				Taihoku			
		Temperature (°c)	Day-length (hour. min)	Days of veg. growth-period		Temperature (°c)	Day-length (hour. min.)	Days of veg. growth-period
Time of sowing	Apr. last decade-May 1st-decade	May Mean 10.5 Min. 4.8 Max. 25.4	May 1 14.04 11 14.28 21 14.52 31 15.06		Jan. last decade	Feb. Mean 14.8 Min. 12.0 Max. 18.6	Jan. 31 10.59 Feb. 10 11.11 20 11.25	
Time of trans-planting	June 1st-2nd decade	June Mean 14.9 Min. 10.0 Max. 27.6	June 10 15.17 20 15.22 30 15.20		May 2nd decade	Mar. Mean 16.9 Min. 13.9 Max. 20.9	Mar. 2 11.39 12 11.53 22 12.09	
		July Mean 19.3 Min. 15.0 Max. 30.7	July 10 15.12 20 14.57 30 14.38			Apr. Mean 20.6 Min 17.3 Max. 25.0	Apr. 1 12.23 11 12.37 21 12.52	about 61
Time of heading	Aug. 2nd last decade	Aug. Mean 21.0 Min. 16.0 Max. 31.2	Aug. 9 14.16 19 13.50 29 13.23	About 66	May 2nd Last decade	Mar Mean 24.1 Min. 20.6 Max. 28.6	May 1 13.04 11 13.17 21 13.27	
		Sept. Mean 16.3 Min. 11.0 Max. 27.5	Sept. 8 12.55 18 12.26 28 11.57				31 13.35	
Time of harvesting	Sept.Last decade-Oct. 1st decade	Oct. Mean 9.8 Min. 4.0 Max. 22.0	Oct. 8 11.28 18 10.59 28 10.32		June 2nd Last decade	June Mean 26.6 Min 23.0 Max 30.1	June 10 13.40 20 13.42 30 13.41	

(3) Comparisons of Day-lengths and Temperatures of the Rice-growing Season in the Cold Countries.

Table 23. Temperature of Hokkaido and Primorsakya

Temperature (°c)		Hokkaido	Primorskaya									
			Southern Ussuri			Nikolsk	Grodekowo	Spasskaya			Others	
		Asahigawa	Vladivostok	Possiet	Novokijewskvje	Nikolsk Ussuriiski	Grodekowo	Spassk	Chelnigovka	Jewyenewke	Bikin	Khabarovsk
Apr.	Mean	3.7	4.7	5.9	5.7	4.4	5.3	4.7	4.0	4.8	4.4	1.9
	Max.	19.4	17.5	25.5	16.0	23.5	22.1	23.8	24.0	21.8	24.3	16.4
	Min.	—10.1	— 7.3	— 7.4	11.0	17.7	11.5	—13.8	—16.4	— 9.0	12.4	—17.2
May	Mean	10.2	9.8	11.1	10.7	10.4	12.1	11.7	12.3	12.5	10.7	12.1
	Max.	26.6	24.4	29.0	29.7	27.8	31.8	29.6	29.9	30.4	31.1	24.6
	Min.	— 3.2	— 0.3	— 3.4	— 0.3	— 3.7	— 0.9	— 3.9	— 4.7	3.4	— 4.2	0.6
June	Mean	15.5	14.5	15.2	15.2	15.6	15.1	17.4	17.8	18.0	16.9	17.3
	Max.	29.2	26.9	27.6	28.2	29.1	33.4	30.5	29.0	32.5	31.7	28.4
	Min.	2.9	4.7	1.5	6.9	0.9	4.1	— 0.2	4.5	13.4	7.2	5.4
July	Mean	19.7	18.9	18.7	19.3	19.7	23.2	21.0	21.2	23.3	21.5	20.1
	Max.	31.5	35.0	31.5	33.9	32.8	40.9	36.5	31.6	39.2	35.1	27.2
	Min.	8.0	8.6	9.5	10.3	9.0	10.4	7.7	7.5	11.0	12.2	9.8
Aug.	Mean	20.5	21.1	20.4	21.0	20.7	21.5	21.2	22.0	21.7	20.5	21.1
	Max.	31.9	31.2	31.8	29.9	32.8	33.9	34.4	35.4	33.9	33.2	28.2
	Min.	9.0	11.6	3.7	16.3	5.0	9.7	6.2	5.9	9.5	10.9	11.3
Sept.	Mean	14.9	16.6	14.5	16.4	14.4	14.3	14.5	14.9	14.3	12.4	14.6
	Max.	27.8	27.2	27.4	28.0	28.1	28.2	27.1	29.0	27.0	27.5	25.2
	Min.	2.8	3.8	— 3.0	4.6	— 2.4	0.2	— 3.1	2.8	— 0.4	— 3.2	4.1
Oct.	Mean	7.8	9.5	7.2	9.0	6.7	7.0	7.0	7.4	7.0	5.3	6.2
	Max.	21.5	22.9	24.2	22.6	22.8	23.7	24.8	23.5	22.7	23.9	15.4
	Min.	— 3.9	— 7.1	— 9.2	— 4.5	—12.8	— 9.5	—10.2	— 9.4	— 9.8	2.3	— 7.1

Table 24. Temperature of Planting Season of the Rice in Hokkaido, Northern Honshu, Korea and Manchuria

Temperature (°c)		Japan					Korea	China				
		Hokkaido		Northern Hanshu			North	Manchuria				
		Asahigawa	Sapporo	Aomori	Akita	Niigata	Yuki	Dairen	Mukden	Chang-chum	I-Mien-po	Mu-tang-Kiang
Apr.	Mean	3.6	5.2	6.9	8.5	10.2	5.4	8.9	8.2	5.9	5.1	4.7
	Max.	9.8	10.4	12.1	13.1	14.3	10.1	13.6	15.0	12.3	11.2	11.2
	Min.	—2.3	0.1	2.1	4.0	6.0	1.3	4.7	1.6	—0.5	1.6	—2.9
May	Mean	10.0	10.4	11.8	13.2	14.9	10.0	15.2	15.5	13.9	12.3	12.4
	Max.	17.2	16.3	17.2	17.9	19.5	14.6	20.0	22.3	20.6	16.9	17.0
	Min.	3.1	4.5	7.0	8.7	10.8	6.3	11.0	8.6	6.7	2.9	2.5
June	Mean	15.2	14.9	16.3	17.9	19.5	14.3	20.3	21.4	19.5	18.2	17.8
	Max.	22.0	20.4	20.8	22.1	23.6	18.0	24.7	27.8	25.6	26.6	27.3
	Min.	9.5	9.8	10.7	14.0	16.0	11.4	16.5	15.3	13.5	12.8	11.9
July	Mean	18.2	18.6	20.8	21.8	23.9	19.2	23.4	24.4	22.8	21.9	21.2
	Max.	25.0	23.7	24.9	25.7	27.8	22.5	26.9	29.8	28.1	27.9	28.5
	Min.	13.5	14.3	17.6	18.4	20.7	16.7	20.5	19.6	18.0	17.9	17.3
Aug.	Mean	19.9	20.6	22.8	23.6	25.7	21.2	24.6	23.4	21.8	20.9	20.6
	Max.	26.1	25.9	27.4	28.2	30.0	24.6	28.0	29.8	27.3	20.2	27.5
	Min.	14.9	15.8	19.1	19.6	22.1	18.2	21.4	18.6	16.9	16.3	16.1
Sept.	Mean	14.3	16.0	18.5	19.0	21.5	16.7	20.0	16.5	14.3	13.1	12.6
	Max.	20.8	21.4	23.6	24.1	25.7	21.0	24.1	23.5	21.1	19.8	20.9
	Min.	9.2	10.5	14.2	14.7	17.9	12.4	16.1	10.5	8.1	7.0	6.2
Oct.	Mean	7.2	9.4	12.0	12.5	15.4	10.2	13.8	9.0	6.2	5.4	4.5
	Max.	14.0	15.3	17.6	18.0	19.6	14.8	18.2	16.0	12.8	11.3	12.7
	Min.	1.7	3.4	7.3	7.7	11.7	5.4	9.6	3.2	0.3	0.9	—1.2

Table 25. Days Free of Frost in Each Country

Stations	First Frost		Last Frost		Average days free of frost
	Mean	Earliest	Mean	Latest	
Asahigawa	Oct. 4th	Sept. 14th	May 24th	July 7th	132
Sapporo	〃 4	〃 9	〃 21	June 28	134
Aomori	〃 23	Oct. 1	〃 4	May 27	170
Akita	〃 23	Sept. 27	Apr. 29	〃 24	176
Niigata	Nov. 22	Oct 25	〃 8	〃 16	222
Yuki	Oct. 15	Sept. 28	〃 24	〃 16	173
Dairen	Nov. 3	Oct. 9	Mar. 31	Apr. 22	206
Mukden	Oct. 2	Sept. 15	May 3	May 18	151
Changchun	Sept. 23	〃 12	〃 1	〃 9	145
Vladivostok	Oct. 22		Apr. 21		183
Nikolsk Ussuriiski	Sept. 30		May 3		149
Grodekowo	Oct. 19		〃 14		157
Jewyenewka	Sept. 25		〃 12		135
Bikin	Sept. 20		〃 28	—	113
Khabarovsk	Oct. 6		Apr. 29		159

4. The Varieties in Taiwan.

(1) The native varieties.

Once the total number of native varieties in Taiwan was 1197. Among them 390 excellent varieties were selected. They were decided as official limited varieties for recommendation and were put under mass selection. The improvement of varieties was planned. The varieties which I collected and investigated (from 1916 to 1918), added to these varieties, were 420 in all. These were able to be the representatives of the Taiwan varieties at that time. And as a result of experimental plantation, the pedigrees were classified into 175. But it was recognized that with respect to practical or commercial value 175 varieties might be still classified into less than a half-number. And there were many varieties which should belong to the same pedigrees in characteristics of rough rice among the above-mentioned number. Their planted area was large and their names were popular. From these respects the varieties which should represent Taiwan native varieties were as follows:—

Table 26. Number of the Native Varieties of the Rice in Taiwan

Ref. No. 12.

	Number of Native Varieties														
	Total			First Crop			Second Crop			Inter-mediate Crop			Upland Rice		
	Total	nonglu-tinous	glu-tinous	Total	nonglu-tinous	glu-tinous	Tatal	nonglu-tinous	glu-tinous	Total	nonglu-tinous	glu-tinous	Total	nonglu-tinous	glu-tinons
Native Varieties	1197	882	315	382	279	103	580	444	136	80	55	25	155	104	51
Recommended Varieties	390	283	107	131	97	34	154	120	34	29	25	4	76	41	35
Ihvestigated Varieties	420														
Recommended Varieties	390	283	107	131	97	34	154	120	34	29	25	4	76	41	35
Others	30														
Representative Varietes of Classification	175	131	44	72	57	15	57	41	16	18	14	4	28	19	9

Table 27. The Representative NativeRices in Taiwan

Glutinous or Non-glutinous	Shape of rough rice	Names of variety-group	Crop-Season	Characteristics of rough rice
Non-glutinous	Long	Ochiam	1st Crop	dull white, or dark dull white, glassy, Ratio of length to width (L/B) about 1.9-2.0, Quality good.
		Chiauka	2nd Crop	dull white, glassy, L/B about 2.0-2.1, Quality good
	Intermediate	Toahoe	1st Crop	pretty big grain, dark dull white, partly glassy, L/B about 1.8-1.9 Quality fair.
		Keha	2nd Crop	small grain, dull white, glassy, L/B about 1.9, Quality good
	Round	Tekonghoele	1st Crop	pretty big grain, dull white, partly glassy, L/B about 1.6 Quality fair.
Glutinous	Long	Banghoe-Chut	1st Crop	L/B about 2.1, Quality fair.
		Hoaniam-Chut	2nd Crop	small and long grain, L/B about 2.3, Quality pretty fair
	Round	Gonug-Chut	1st Crop	L/B about 1.6, Quality fair.
		Gonug-Chut	2nd Crop	

Shape, dimension and quality of rough rice throughout all the varieties:- average ratio of length to width is 2.0, average weight of 1000 grains 18.7 gr., that means, a grain is long and little. The varieties of round grains are not many, *i. e.*, those varieties whose ratio of length to width is less than 1.6 are only three. Once, forty representative varieties were selected and were crossed in all combinations among them. But among these 1560 hybrid populations, the rice of round grains couldn't be found. The glutinous *Chut* is exceptional.

When white rice is boiled, it lacks viscosity. While it is hot, it is fragrant and tastes good. But when it gets cold, the flavour is almost lost and the viscosity and good taste are strikingly lost. The mode of fluctuation of water contents which comes from absorption and evaporation of moisture according to outside moisture while paddy or rice is stored, is a little lower than in the case of Japanese or *Horai* rice. Perhaps it is due to the character of starch. The quality of round-glutinous grains (round *Chut*) is a little better. When *Mochi*, pounded rice-cake made of glutinous rice is soaked in cold water, the degree of turbidity and breaking is more rapid and larger than that of Japanese varieties.

In the past the varieties which have over 5,000 *ko* of planted area were as follows:—

First Crop. *Ochiam, Pehbihun, Okhakchhengin, Ekhaliuchin, Oliap.*

Second crop. *Chhikochiam, Pehkhak, Thianlai, Bana, Chiauka, Chhinko Keha, Pehkhakinliap, Hoana, Okhakchhengiu, Gonug-Chut, Toa-Chut.*

The planted area of *Ochiam, Chhikochiam, Pehkhakthianlai, Bana* and *Chianka* amounted to over 10,000 *ko, Gonug-chut* to 56,000 *ko.*

Several characteristics of Taiwan native variety are as follows:—

Leaves: the colour, to compare with Japanese variety, is light green though there is some difference of shade. The difference is especially conspicuous during the period from producing of first leaves of seedlings to heading. Glutinous variety (*Chut*) is an exception. On the surface of leaves, hair is developed and it is ordinary that thin hair grows luxuriantly on the central

vein near the sheath. Excepting upland variety, external appearance of the leaves is comparatively narrower and longer than those of Japanese varieties.

Stem: The stem is generally more frail than Japanese varieties and is easy to lodge, so it is not suitable for straw work. The ratio of the increase of straw weight to weight of paddy, which is caused by the increase of Japanese variety, and that of 2nd crop variety is still larger than 1st crop variety. As far as the poise of tillers is concerned, there is difference of successive degree between the following two, *i. e.* one in which the angle of a stem to the ground is small and upper part of the stump is strikingly open and the other in which the angle is large and the upper part is closed. Most of the native varieties belong to the former, while most of Japanese varieties belong to the latter.

Ears: Weight of ears, chiefly because of smaller grains, is lighter than that of Japanese varieties. Concerning the shape of ears, the angle of rachilla to rachis, is mostly larger than that of Japanese varieties. The pendency of rachis in Japanese varieties is semicircle, and in most of the native varieties it is near to an arc. Accordingly the conditions of the rice-fields after ripening are different from each other. Ears of most of native varieties are easy to be shattered, falling off the grains because of the striking development of abscissional tissue after yellow ripe at the joint of spikelet to rachilla.

Paddy: In general, paddy grains of the native varieties are long and small. While in Japanese varieties they are oval and most paddy grains are yellowish white or yellow though sometimes they are brownish yellow or black. In native variety paddy is a crooked, rather wedge-shaped semicircle. Chaffs are brownish yellow colour, and there are many varieties which are shaded by fine blackish brown granule as it is called *Okhak*. Average weight of 1000 grains is 23.3 gm. The volume weights of paddy and rough rice, and the ratio of weight of rough rice to paddy are lower than that of Japanese variety. There is a tendency that the white mealy part of abdomen of rough rice is generally larger than that of Japanese variety. Hairs on palea are generally short. But there are exceptions. When the seeds of native variety are soaked in the water before sowing, they absorb water more quickly

and they produce the germination heat more quickly in the course of pre-sprouting procedure which accelerates the growth of seedlings in the nursery of the first crop, than Japanese varieties.

Other characteristics: Sensibilities to day-length and temperature in the growing period have been already mentioned. Resistant character against blast disease is mentioned in another section. The ill effect of coldness during the nursery period of the first crop is greater than that of Japanese varieties. The influence of the number of days of nursery on the growth after transplanting is extremely conspicuous, but rather weaker than that of Japanese varieties.

It is common that high percentages of sterile epikelets are produced in F_1, crossed between Japanese and native varieties. Among the segregated lines in F_2, the ratios of sterile spikelets are deviated 0—100% according to parent-varieties.

In most of the above-mentioned varieties which were decided to be official recommended varieties, pure line selections were carried out. And improved varieties were once distributed throughout the island many years ago. However the quality of the rice from these seeds is not comparable to that of the Japanese and *Horai* rices or the *Gen*-rice of Kiangsu.

(2) Japanese Varieties with Special Reference to the Adaptabilities in the Tropical Regions of Low Latitude.

The total number of Japanese varieties for experiments in Taiwan is 1256, comprising almost all the varieties in Japan. In 1922 I made clear the way of plantation in Taiwan of low latitude. As soon as the time was ripe for the plantation, we selected good varieties, increased and distributed them. Then the foundation was established. After that, according to the gradual diffusion and improvement, the standard to select varieties has been changed. The first distributed variety was *Nakamura* which was similar to *Miyako.* To this *Sagamansaku* was added in a part of Shinchiku Prefecture. Thus the total of the planted area through the northern and middle parts of Taiwan Island was over 111,000 *ko* in 1926. But the first crop in that year mer with record-breaking unfavourable weather and was severely damaged

by blast disease. After that *Nakamura* has been on the downward path and also *Taichu Toku* No.2 (separated from *Shinriki*) which was planted to some extent in the middle part of Taiwan was almost annihilated by leaf-blast. Instead of *Nakamura*, *Kagi Ban* No.2 appeared. This variety was separated from *Iyosengoku* and could avoid the damage by blast disease in the same year. It was planted through the northern and central parts, and the southern part where it was considerably difficult to plant *Nakamura*. Everywhere it displayed results of abundant yield. Especially in the section of Kanan-Taishu irrigation system which was one-crop-a-year region, *Kagi Ban* No.2 was planted as a whole, showing an excellent result. Then the plantation in that irrigated region was profitably stabilized. The statistics of the planted area in 1931 were said to be over 47,000 *ko*. But in my tour of inspection, I found that the planted area of chief rice-producing districts in Taichu Prefecture was estimated and reported by the names of other varieties. Therefore I supposed that actual area exceeded the area of these statistic figures. Thus *Kagi Ban* No. 2. amazingly increased the stability to plant the Japanese varieties. But here we must notice the following characteristcs. To compare *Kagi Ban* No. 2 with *Nakamura* and many of other Japanese varieties the heading of the former was not so consicously prompted by short day-length as the latter varieties. Therefore the number of nodes and the variations of number of growing days according to the season were not conspicuous. The season suitable for plantation of *Kagi Ban* No.2 was not so particular as other varieties. Also in the second crop it could easily display the superior yield. *Yokichisen* and *Aikawa* which could escape the damage of blast disease as well as *Kagi Ban* No.2 had also these characteristics. Their growing and yield were excellent, too. These discoveries not only formed an epoch in the selection of the Japanese varieties, but also gave us a guide to the selection of bred varieties which were being crossed and grown. Up to date (considering this guide as a principle and adding to it the high yield and popularity of quality in the market) I have decided recommended varieties.

In the time of transition when *Kagi Ban* No.2 appeared, *Asahi* and its

group were added the next year, *Aikoku* and its group, two years later. The former which were of specially good quality, were popular in the export market and planted area in 1935 was 20,638 *ko* through the central and northern parts of Taiwan. The latter had a little stronger resistant against blast disease. The planted area in 1936 was the largest and after that it has been decreased.

Since 1926 it has been generally assumed that the Japanese variety was weaker against blast disease while the native variety was stronger. So severely was the damage which *Nakamura* suffered in that year. But it did not mean that the native varieties were free from the attack. Botanical pathologists investigated the degree of many varieties belonging to both categories. The results did not correspond to what was generally believed. It was because that people in general unconsciously compared the damage of *Nakamura* with that of all the native varieties. Even after that there has been this tendency to compare the damage of a few of the Japanese or *Horai* varieties with that of all native varieties. The following two tables prove this.

Table 28. Comparison of Damage Percentage of Japanese Varieties by Rice-blast Disease With that of Native Varieties (Taihoku, *vide* SAWADA *et al*, 1927).

Year	Number of Varieties investigated		Percentages of damage				Percentages of damaged Culms	
			Ears		Nodes			
	Japanese Varieties	Native Varieties	Japanese Varieties	Native Varieties	Japanese Varieties	Native Varieties	Japanse Varieties	Native Varieties
			%	%	%	%	%	%
1921	157	114	26.3	49.6	—	—	26.3	49.6
1922	155	84	7.5	15.2	2.1	5.8	8.7	18.7
1923	154	122	4.2	31.0	2.0	18.5	5.5	40.3
1924	189	238	7.1	10.8	3.9	11.2	9.7	18.5
1925	190	120	3.1	6.1	4.8	8.8	7.1	13.0
Average			9.6	22.5	3.2	11.1	11.5	28.0
1926	68	42	48.3	35.4	12.8	16.1	54.2	47.8

Remark: Damage Percentage of Var. *Nakamura*
1921-25. Average 14.9% Max. 25.4% Min. 1.3%
1926. Ears 69.2%, nodes 30.8%, damaged culms 84.6%

Table 29. Frequency Distributions of Varieties According to Damage Percentage by Rice-blast Disease (SAWADA *et al*, 1927).

Damage Percentages by rice-blast disease in first crop	Frequency distribution of Varieties						
	Taihoku Agr. Exp. Sta.			Taichu Agr. Exp. Sta.	Seira, Tainan Pref.	Takao Pref.	Heito, Takao Pref.
	Japanase Varieties	Native Varieties	Recommended Native Varieties	Native Varieties	Native Varieties	Native Varieties	Native Varieties
More than — Less than							
% 0 — %	1	—	7	1	—	3	4
0.1 — 1	5	1	1	2	—	10	6
1 — 2	10	3	6	1	—	13	3
2 — 3	12	1	12	—	—	4	3
3 — 4	15	3	6	—	—	2	2
4 — 5	9	1	10	—	—	3	2
5 — 7	23	2	11	2	—	4	1
7 — 10	38	9	10	4	2	11	1
10 — 12	14	6	2	4	—	2	1
12 — 15	19	9	4	—	1	1	—
15 — 17	14	14	3	4	1	—	—
17 — 20	12	15	13	3	1	—	—
20 — 22	9	11	3	3	1	1	—
22 — 25	7	12	1	2	—	1	—
25 — 27	5	8	6	4	—	1	1
27 — 30	2	2	1	3	1	—	—
30 — 40	2	22	3	19	2	—	—
40 — 50	2	22	3	18	2	—	—
50 — 60	—	11	1	16	2	—	—
60 — 70	—	6	3	4	—	—	—
70 — 80	1	1	—	3	—	—	—
80 — 90	1	—	1	2	—	—	—
90 — 100	—	—	1	1	—	—	—
Total	201	159	108	106	13	56	24

Remarks: 1. Taihoku 5 Years' average (1921-25); Taichu, 3 years' average (1923-25) Seira and Takao Pref. 2 years averages (1923-24);
Heito Agr. Exp. Sta. 4 years average (1921-23, 25)
Recommended Native Varieties—Officially recommended in Central and Northern parts in Taiwan

It must be avoided to decide immediately whether resisting power of both varieties against blast disease is strong or not, or to make light of the resisting power of the native variety. One must minutely study what the cause of the degree of damage is.

Leaves are very scarcely infected by rice-blast disease while they are seedlings. During the period from transplanting to tillering they become more susceptible to it. From available tillering to maximum tillering, *i.e.* forty or fifty days after transplanting, they are damaged most severely. After the maximum tillering, the resisting power grows and the strongest resisting power is kept from that time to ripening stage.

Ears are susceptible to blast disease during heading. As far as heading is concerned, it takes 60-70 hours from its beginning to the end. Generally it takes ten days or so for the heading in a clump. As regards the progress of heading in one day, it is rather slow from midnight to the early morning, and it gets rapid in the daytime. After heading the resisting power increases. Resisting power during the susceptible period considerably changes according to temperature and environment. The cause exists in anatomical and biochemical changes. Also this resisting power is according to the difference of variety, growing period and vegetative conditions. If temperature and moisture suitable for the propagation of the disease during the growing period continue long, the degree of contracting disease becomes high. The period of the first crop in Taiwan, as far as this propagation of blast disease is concerned, is in the limitation of suitable temperature (25-30°C). It is rainy and moist. There are enough elements for epidemic. Therefore the degree of contracting disease and damage is necessarily high if the plant heads before the factors are moderated by improvement of the weather. If heading is after that boundary, the degree falls. Most of the Japanese varieties head before the boundary while most of the native after it. Therefore both how to avoid to contract the disease, and how to resist against it must be investigated. If even the famous Japanese resistant variety from old times heads before the boundary, the considerable damage is inevitable. On the

contrary, even in those varieties which are recognized to have weak resistance, if in a certain year it is fortunately fine in the heading period before the boundary, the plants do not contract the disease, are of good quality and produce high yield. *Nakamura* is an example for this. With respect to the second crop, this kind of epidemic factor is greatly moderated and the resisting power is in proportion to temperature in the growing period (if it exceeds proper temperature, the proportion is deranged) until temperature as well as soil temperature becomes suitable for growing. Because of this proportion and partly because of the gaining of the resisting power by the high temperature in the second crop, there is little danger of being damaged by the prevalent blast disease.

In subtropical Taiwan it is only for quite a short time in a year (below 19° C or over 32°C) that the growth of the blast fungus is controlled by temperature. Accordingly other epidemic factors, such as rain and its distribution, nutritious conditions and genetical resistant character of varieties, should be regarded as of great importance. That is, the degree of damage caused by the disease depends upon the correlation among the meteorological factors, the developments of the cells and tissues of leaves or stems, and their chemical contents. And the importance of the selection of variety as well as the improvement of cultural method must be considered more carefully. To compare with the principle to defend the disease, it is still more important to protect the plant against the disease, and to give resistant character against the host as well as to annihilate the disease-fungus, because the parasitic fungi are active almost all the year in Taiwan. In these days, the newly planted varieties of *Horai* have been distributed and if the degree of damage by the disease in these varieties is compared with *Nakamura* in the past days, the former degree becomes conspicuously low. Of course it is partly because of the spread of knowledge to defend the disease and of the gradual distribution of those varieties whose resistant character is much stronger than that of *Nakamura*. But it is greatly due to the fact that we paid much attention to the selection and plantation of such varieties as were able to avoid the

ear-blast disease, considering the above-mentioned points. In the cases of *Kagi Ban* No.2 and *Kagi Ban* No.1, they were of late varieties and were not so sensible to short day-length as other varieties. It seems that these characteristics were useful to avoid the damage. *Shinriki* which was on the verge of annihilation by leaf-blast disease could defend ear-blast disease. This variety had morphological and mechanical characteristics in heading but was of lateness. *Nakamura* often suffered the damage of the same degree after 1926. The reason why *Nakamura* was rapidly spread in the early stage of the distribution of Japanese varieties was this: the weather was favourable in those three years, so growth of this variety looked strikingly good; moreover, it was stimulated by the discovery of the way to culture Japanese varieties, by the fact that the popularity in export-market was elevated and also by the profitableness to export early harvest. In the future, in order to grow and select a new variety, it is quite necessary to think over these points. At any rate, the degree of the damage caused by the blast disease in the first crop still remains in the rice-planting of Taiwan as an unsolved problem which needs further research.

I shall omit the differences of response-character against day-length and temperature between the Japanese and native varieties and also the difference of other characteristics between these two categories, for I have already mentioned them in each section in contrast to each other. But, concerning the days of nursery period as a characteristic after transplanting, I shall explain a little. It is necessary to shorten the nursery period in Taiwan situated on low latitude, to compare it with that in Japan, the original home of the varieties. The reason is this: even in native variety, when the number of days of nursery period is 30-100 days in the first crop and 10-80 days in the second crop, the modes of the frequency distribution of the correlation coefficients of growth after transplanting are as shown in next table. In the case of Japanese variety, this phenomenon is extremely conspicuous. To expect abundant harvest by the intensive culture with much quantity of fertilizer, Japanese variety is far more excellent than the native variety. As

far as the power to bear extensive culture of no or little fertilizer is concerned, native variety is more adaptative.

Grains of the Japanese rough rice are more round and bigger than those of the native. The average weight of 1000 grains is 24.0 gr.; the average ratio of length to width is 1.73. Because of the difference of biochemical characteristics of contents, when the Japanese white rice is boiled, it is viscous, fragrant and has excellent taste either when it is hot or cold, and these are not lost so strikingly as in the native variety. The quality of Japanese varieties produced in Taiwan is almost the same as that of the one produced in Japan.

Table 30. Correlations between Days of Nursery-Poriod and the Growing Characters of the Rice. Ref. No. 14, 15.

Between the Characters X and Y		Correlation Coefficients	
X	Y	First Crop	Second Crop
Days of Nursery Period	Length of Culm	− 0.61	− 0.88
〃	Number of Tillers	− 0.38	− 0.53
〃	Days from Sowing to Heading	+ 0.72	+ 0.89
〃	Days from Transplanting to Heading	− 0.82	− 0.99
〃	Standard Deviation of Heading	+ 0.76	+ 0.70
〃	Yield of unhulled rice	− 0.89	− 0.82
〃	Total Carbohydrates of Seedlings (%)	+ 0.52	+ 0.64
〃	Total Nitrogen of Seedlings (%)	− 0.77	− 0.88
〃	Carbon-Nitrogen Ratio	+ 0.90	+ 0.59

(3) *Horai varieties:*—

Horai Rice:- The name "*Horai* rice" was publicly informed on the fifth of May in 1926. It was a commercial name given to the rice which was produced from the Japanese varietie planted in Taiwan.

Horai Varieties:—This term was not especially informed publicly. But it came to pass unnoticed that for the convenience' sake people gave the name "*Horai* Varieties" to such varieties of the rice plant as produced *Horai* rice. Gradually this term has been adopted in the statistics.

Present *Horai* Varieties:—As I have repeatedly mentioned, the excellent abundant harvest can be expected from most of those Japanese varieties which have keen sensibilities to light and temperature and whose inherent minimum days of vegetative growth are short, with such care as to transplant in the period by extremely shortening the days of nursery in intensive culturing with plenty of fertilizer. However, difficulties are unavoidable to spread this variety in general. Only several Japanese varieties are safely cultured for they are of special types having rather dull sensiblities. The characteristics of the varieties of *Keng* and *Nou* (non-glutinous and glutinous) fitted for Taiwan belong to special type different from the general Japanese varieties. On the cross breeding we attach great importance to this respect and try to select new Taiwan varieties of *Keng*. Until 1934 crossed combinations of Japanese varieties had been 5223. If the combinations after that time were added, they would be over 5500. Among this number the combinations of the Japanese varieties with the Taiwan native ones and the *Hsien*-varieties of other countries are included. Thus for a long time an enormous number of pedigree-groups has been selected repeatedly. The pedigree-groups which are kept today are extremely condensed hereditarily. The excellent *Horai* varieties which are planted generally are descended from these pedigree-groups. To these pedigree-groups such trials are continuing: to cross these with those which have more excellent characteristics, to elevate the value of the pedigree-groups as the materials for breeding by strict selection and to make many chances for the appearance of excellent varieties of each locality. To suppose from the past experimental and practical results, it can be recognized from many cases on the crosses of Japanese variety-group 1 that the excellent *Horai* varieties are constructed by the recombinations of factors among hidden characters as well as those which appeared in phenotype.

The total number of the varieties which have been recorded as excellent cross-bred varieties of *Horai* until today is 131. The pedigrees which are recognized to be especially excellent varieties are as follows:

Table 31. Hybrid Populations which Produced Excellent Vaireties of *Horai* Rice.

No.	♀	♂	Examples of bred-varieties of *Horai*
1	Shimehari	Iyosengoku	Taino No. 16, Shinchiku No. 4
2	Iwata-asahi	Iyosengoku	Taino No. 18
3	Iyosengoku	Aikoku	Taino No. 23
4	Asahi	Kairyoaikoku	Taino No. 34, 35.
5	Shimehari×Iyosengoku	Kameji×Shinriki	Taino No. 45.
6	Sakai-Kaneko	Kameji×Shinriki	Taino No. 46
7	Aikawa	Shimehari×Iyosengoku	Taino No. 47
8	Kameji×Shinriki	Iyosengoku	Taino No. 48.
9	Kameji×Shinriki	Aikawa	Taino No. 49.
10	(×Asahi)×{Toyokuni×(Kameji×Shinriki)}	Toyokuni×(Kameji×Shinriki)	Taino No. 53, 54, 55
11	Iyosengoku	Tango-Chuto	Taino No. 37
12	Yanagi-mochi(Shimehari×Iyosengoku)	Hassen-Mochi	Taino-Mochi No. 5
13	(Shimehari×Iyosengoku)×Myojn-moehi	Hassen-Mochi	Taino-Mochi No. 7, 8
14	Kyonishiki×Osaka Asahi	Meijiho×Yokichisen.	Taihoku No. 8
15	Asahi	Pehbkiimkau	Taihoku No. 181
16	Chhikohon	Kameji×Shinriki	Taihoku No. 182
17	Kameji	Shinriki	Taichu No. 65
18	Kameji×Shinriki	NC No.4=Italian variety × Japanese Variety;	Taichu No. 114, 150.
19	NC No. 4×(Kameji×Shinriki)	Ancestors unknown	Taichu No. 152, 155
20	(Kameji×Shinriki)×NC No. 4	(Kameji×Shinriki)×(Nakamura×Shinriki)	Taichu No. 153.
21	Blue rose	{(Miyako×Ochiam)×Shinriki}×(Kameji×Shinriki)	Taichu No. 264
22	Hassen-mochi	Kameji×Shinriki Yubo Asahi	Taichu-Mochi No. 59
23	(Miyako×Chiathau Gonugchut)×Shinriki	Kameji×Shinriki	Taichu-Mochi No. 46
24	Hassen-mochi	(Kameji×Shinriki)×NC No. 4	Taichu-Mochi No. 60
25	{(Miyako×Chiathau Gonug Chut)×Shinrik}×Sheinomochi	(Miyako×Chia Thaugonug Chut)×Kameji×Shinriki)	Taichu-Mochi No. 61
26	(Miyako×Chia thaugonug Chut)×(K meji×Shinriki)	{(Miyako×Chiathaugonugchut ×Shinriki}×Sheino-mochi	Taichu-Mochi No. 62
27	{Yanagi-mochi×(Shimehari×Iyosengoku)}×Hassen mochi	Yoshino No, 1 Kameji×Shinriki	Taichu-Mochi No. 66, 67.
28	Gonug-chut×(Shinriki Aikoku)	Takenari×Kinaichusei No. 76	Kanan No. 2, 8,
29	Kairyo-Aikoku	(Kameji×Shinriki)×NC No. 4	Takao No. 10
30	Kairyo-Aikoku×(Takenari×Kinai-Chusei No 76)	Oita Benkei×Chiba Nishiki	Takao No. 18.
31	(Shimehari×Iyosengoku)×(Kameji×Shinriki)		Kllo=Kwon Fou No.1 or Kofuku No. 1

Remarks: There are such inclinations:- When the new varieties show high yielding character, they are always the varieties which are crosssed by Taichu No. 65 (Kameji×Shinriki) and when showing the excellent taste of boiled white rice they are

always the varieties which are crossed by Taino No.16 (Shimehari×Iyosengoku), Iyosengoku, Iwata-asahi or Takenari.
Taino-Mochi No. 46 has the best glutinous quality among *Horai* glutinous varieties. But still there is room to improve.

Taihoku No. 8 (Taihoku Prefecture), *Shinchiku* No. 4 (a part of Shinchiku Pref.), *Taichu* No. 65 (the whole island, Taichu Pref. being the center. The planted area through Taiwan and Ryukyu is 246,349 *ko*, in 1936), *Taichu* No. 150 (Taichu Pref. is the center and it spreads amid the area distributed with Taichu No. 65), *Taichu Mochi* No. 46 (the whole island), *Kanan* No. 1, No. 8 (Tainan Pref.) and *Takao* No. 10, No. 18 (Takao Pref.).

In the past, other cross-bred varieties contributed to the improvement of *Horai* variety according to the times, sometimes prospering and sometimes declining locally in the distribution of the plantation, *i. e. Taino* No. 1-No. 5 (Taihoku Pref.), *Taino* No. 23 (Sea-shore in Tainan Pref). But they include in *Taichu* No. 65 unnoticed. It is because of the popularity of *Taichu* No. 65.

New cross-bred varieties of Taichu Pref. in recent years are *Taichu* Nos. 155, 164, 166, 167, and *Taichu Mochi* Nos. 66, 67. According to the experimental results, these varieties of *Keng* produce little more abundant harvest than *Taichu* No. 65, while *Taichu Mochi* No. 66 and No. 67 little better than *Taichu Mochi* No. 46.

New cross-bred varieties in Takao Pref. are *Takao* No. 12 and No. 18. In this district they produce better yield than *Taichu* No. 65. Especially *Takao* No. 18 shows strong resistance against the blast disease and the sclerotial disease. As far as the blast disease is concerned, *Taichu* No. 150 is stronger than *Taichu* No. 65 and with respect to the quality of boiled white rice, the former is better than the latter. But there is such a tendency that No. 150 is of little earliness and its yield is rather less than *Taichu* No. 65. Recently Kllo (*Kwon Fou* No. 1 or *Kofuku* No. 1) is strong against the rice-blast disease, showing high yield.

Kanan No. 8 was experimentally planted in Taihoku, Shinchiku, Tainan and Takao Prefectures, and the result was that its yield was little better

than *Taichu* No. 65. It is recognized as a later variety than *Taichu* No. 65.

Taino No. 34, No. 42 and No. 45 are comparable to *Taichu* No. 65 in Tainan Pref. Takao Pref., and Karenko Pref. situated in the eastern part of the island, or produce more abundant harvest. Especially *Taino* No. 45 is excellent. Its quality and taste are good. The taste of *Taino* No. 34 is good, too. *Shinchiku* No. 4 is an early variety of expecially good taste, good material for brewing, and of little grains.

Taino Mochi No. 5, as far as the quality and taste as *Mochi* (pounded rice-cake) are concerned, is far superior to *Taichu Mochi* No. 46. As regards *Taino Mochi* No. 7 and No. 8, they are expected to be better than *Taichu Mochi* No. 46.

Thus the foundation of mass production of *Horai* rice by cross-bred varieties and its popularity of the market were made solid by the fact that *Taichu* No. 65 appearing next to *Kagi Ban* No. 2 was distributed through the whole island. Recently to go forward, men, aiming at local mass producing district of 100, 000-300,000 or 400,000 *koku* in general, have tried not only to plant varieties better than *Taichu* No. 65 in yield and quality and to contribute to the increase of production, but also to elevate the profit of growers by special fames of rice produced in each locality.

With respect to the modal value of fluctuation phenomenon of water contents during the storage of paddy or rough rice, *Horai* and Japanese varieties are a little higher than the native varieties, but it falls and approaches to the modal value of the native ones if the degree of dryness is beyond a certain limit. Also when the period of storage of *Horai* or Japanese paddy or rough rice is long, the same phenomenon appears. Thus viscosity, taste and fragrance of boiled white rice fall. These characters are very excellent in *Suboshi*-rice (*Suboshi* method: half shading dry method of paddy, projected by the writer) if compared with usual direct sun-dried rice. The former is glassy while the latter is somehow mealy. If the temperature of *Suboshi* is compared with that of drying in direct sun-light (about 40.7° C in the first crop, 30.8° C in the second crop in average, Taihoku), the former is over

10°C lower than the latter

As a biochemical phenomenon, starch made in the proper drying below the limit has the highest viscosity and amylose increases according to drying and its saccarization becomes easier as the period of storage passes.

On the contrary, amylopectine decreases and there is a tendency that amylopectine is hard to decompose. When the degree of drying is slow, iodine reaction of starch is very blue while red is less. But when the sun-drying progresses, blue decreases and red increases. The decoloration phenomenon of methylene blue becomes striking as the sun-drying progresses (Rosenheim-Schüsterscolorimeter No. 91). The reaction of peroxydase becomes weak on the contrary. And the action of enzyme of both peroxydase and katalase declines weak as the storage period passes on. The turbidity of cold water extract increases as the sun-drying progresses. The viscosity of hot water extract and quantity of soluble solid matter of white rice is properly dried. Most part of solid matters is starch and dextrine. The reducing sugar decreases and non-reducing sugar and dextrine increase as the sun-drying progresses.

As to protein, soluble proteins decrease according to the drying, while insoluble protein increases (*Vide* ISO, 1944; MIYAKE & WATANABE, 1933, 1935).

The rice dried properly is lustrous and glassy, and viscosity, taste and fragrance of boiled white rice are very good, especially excellent in *Suboshi*-rice. Cooking quality of white rice in taste is to be deteriorated if dried lower than 13% of moisture in rough rice, in regard to the physico-chemical change of the constituents of the grains as above-mentioned. The marginal moisture content of this change is about 13.0-13.5%. If drying in the direct sun-light is carried on till moisture content is below 12.0-11.0%, that change is certain. However, in the case of desiccation by low temperature, as in *Suboshi* method, the change is not remarkable.

As far as the difference of chemical constituents between direct sun-dried rice and *Suboshi* rice is concerned, in the latter case soluble protein is more than that in the former case. Viscosity of starch is stronger and also the

absorption power of moisture is different. In *Suboshi*-rice amylose is less while amylopectine is more than in direct sun-dried rice. In *Suboshi*-rice iodine reaction of starch is very blue while red is less than in direct sun-dried rice, and cold water extract of *Suboshi*-rice is clearer than that of direct sun-dried rice (KOBE'S Nephelometer). These are because that generally in the case of direct sun-dried rice desiccation by high temperature brings physico-chemical change to constituents of rice more than *Suboshi*-rice.

It seems that the summary of these chemical phenomena suggests the difference of characters between the native rice and *Horai* or Japanese rice. Practically men are distinguishing the native rough rice which is mixed in *Horai* or Japanese rough rice by the difference of the shape and size between them, but sometimes by the colorification, reddish brown on the outer layer of grains, soaking a small sample about ten minutes in 5 c.c. of 2% solution of guaiacol adding 6 drops of Oxyful (H_2O_2) (about 1/20 of guaiacol solution). The former changes to a deep color while there is no striking change of color on the latter.

Chapter III. **The Yield of Rough Rice per Unit Area.**

The following is the amount of rough rice per *tan* by the data which I could collect:—

China Proper:- The annual production of rough rice per *tan*(the average from 1932 to 1936) is 1.311 *koku*. It is over 1.291 *koku* which is the annual average from 1883 to 1887 of Japan and below the annual average of the next five years.

Taiwan:- The average per *tan* from 1898 to 1902 is 0.727 *koku*, almost equivalent to that of Hainan, French Indo-China and the Philippines. But the average from 1936 to 1940 is 1.404 *koku*, the increase of 93% in 45 years. This corresponds to that in Japan from 1888-1902. About this increase, I will discuss later.

Japan:- Average of five years 1878-1882, 1.160 *koku*
Average of five years 1936-1940, 2.056 *koku*
Increase in 65 years, 75.8%

It is recognized that the inclinaton of accurate increase is after 1888. Generally speaking, there is an increase of 50% in 50 years, 1% a year increases and is accumulated. This period was an age when the Government did their best to distribute excellent varieties and to lead the technic of culture.

Korea:- Average of three years, 1910-1912, is 0.788 *koku*. It is just like Taiwan 45 years ago. However the average of five years, 1936-1940, is 1.355 *koku*, *i. e.* the increase is 71.9% in 33 years. This corresponds to the period from 1888 to 1897 in Japan. In 1910 a Japanese variety called "*Kokuryo Miyako*" began to be spread as an excellent variety in Korea. After that, as I have already shown, many Japanese varieties have been planted and spread.

Table 32. Average Yields of Rough Rice Per *Tan* (*koku*)

5 Years Average	China Main land	Taiwan	Japan	Korea	Remarks
1878– 82			1.169		A. Statistics Bureau Dept. Accountant, Gov. China Republic.
„ 83– 87			1.291		(Converted into *ha*, *koku* by Toakenkyusho)
„ 88– 92			1.420		B Agr. Report. Cent. Agr. Expt. Sta. Gov. Chine Republic
„ 93– 97			1.358		(Converted into *ha*, *koku* by Toakenkyusho)
„ 98–1902		0.727	1.498		Others.
1903– 7		0.929	1.604		Staistics Bureau, Dept. Agriculture and Forestry, Gov, Japan.
„ 8– 12		0.919	1.711	0.788 (1910–12)	
„ 13– 17		0.983	1.808	0.891	
„ 18– 22		0.989	1.888	0.934	
„ 23– 27		1.100	1.804	0.959	
„ 28– 32	A. 1.406 (1932)	1.196	1.872	0.965	
„ 33– 37	B 1.215	1.339	1.964	1.192	
„ 38– 40 (3years average)	(1932–36 average 1.311	1.411	2.040	1.306	
„ 36– 40		1.404	2.056	1.355	

	koku
Hainan	0.600 (about)
French Indo-China	0.601
Philippines	0.629
Burma	0.725
Siam	0.820

Table 33. Planting Area of the Rice and Production of Rough Rice in China Mainland.

		Planting areas (1000 ha)	Production of rough rice (1000 *koku*)	Production of rough rice per ha (*koku*)	Production of rough rice per *tan* (*koku*)
China Mainland		20,526.0	271,364.5	13.22	1.311
Ningsia		15.5	176.0	9.30	0.922
Tsinghai		—	—	—	—
Sinkiang		103.0	1,071.0	10.40	1.031
Kansu		16.0	192.5	9.55	0.947
Shensi		136.5	1,515.5	10.86	1.077
Hwapei (Northern China)	Shansi	13.5	120.0	7.41	0.735
	Hopeh	77.0	530.0	6.88	0.682
	Shantung	17.5	122.5	8.30	0.823
	Total	108.0	772.5	7.69	0.763
Honan		203.5	1,674.5	8.40	0.883
Hwachung (Central China)	Kiangsu	1,884.5	4,524,213.0	13.04	1.293
	Anhwei	1,275.0	5,014,967.5	11.53	1.143
	Hupeh	1,631.0	1,021 299.0	13.32	1.321
	Hunan	1,710.5	28,130.5	16.58	1.644
	Kiangsi	1,718.0	22,144.0	12.74	1.263
	Chekiang	1,750.0	23,084.5	13.21	1.310
	Total	9,935.0	133,838.5	13.43	1.332
Szechwan		2,820.0	41,140.5	14.59	1.447
Hwanan (Southern China)	Fukien	928.0	12,864.5	13.82	1.371
	Kwangtung	3,236.5	41,650.0	12.87	1.276
	Kwangsi	1,556.0	18,106.0	11.21	1.112
	Total	5,720.5	72,621.0	12.69	1.258
Kweichow		670.0	8,976.0	13.14	1.303
Yunnan		795.5	9,886.5	12.39	1.229

Table 34. Average Yields of Rouh Rice per *ko* in Taiwan

Dept. Agr. Comm. Gov. Taiwan

Year	Planting Areas (*ko*)						Average Yield of Rough Rice per *ko* (*koku*)					
	Common Rice				Upland Rice	Total	Common Rice				Upland Rice	All Average
	Horai Non-glutinous Variety	Native Non-glutinous Variety	Glutinous Round	Glutinous Long			*Horai* Non-glutinous Variety	Native Non-glutinous Variety	Glutinous Round	Glutinous Long		
1921	—	420761	51011	.....	39019	510791	—	10.202	8.613	.....	6.257	9.742
„22	421	426842	61031	.....	38795	527096	17.083	10.836	9.391	.....	6.048	10.330
„23	2438	423560	60065	.....	37470	523578	15.692	9.770	8.134	.....	5.351	9.294
„24	25078	415072	66923	.....	40859	547932	13.831	11.449	9.921	.....	7.680	11.090
„25	70827	369746	85048	.....	42297	567918	14.015	11.569	10.369	.....	6.828	11.345
„26	123269	335597	65663	18953	41280	584762	10.609	11.243	9.555	12.270	7.066	10.627
„27	102564	370831	67704	21192	40813	603154	12.296	11.826	10.135	11.445	7.909	11.438
„28	134220	333072	78496	21078	36192	603058	12.100	11.427	10.587	11.112	8.277	11.268
„29	102310	358264	73563	18450	32979	585566	12.661	11.226	10.111	10.331	6.952	11.068
„30	135237	370354	68080	18671	41102	633444	13.356	11.708	9.623	11.370	8.780	11.636
„31	147448	370784	72552	22371	40225	653380	12.945	11.655	8.441	11.833	9.263	11.448
1932	193942	346501	80603	21455	42427	684928	15.173	12.780	10.878	13.085	9.910	13.066
„33	237429	313870	81089	18713	45323	696424	14.430	11.501	9.929	10.814	7.028	11.027
„34	269527	284985	72571	16699	42882	687664	15.903	12.268	10.249	12.192	8.180	13.217
„35	304985	262960	71769	17684	42277	699675	14.742	12.232	11.658	11.832	8.600	13.038
„36	299918	271276	74765	16616	41010	702685	15.515	12.907	11.525	12.708	8.411	13.603
„37	312870	278953	38951	9482	37826	678082	15.288	12.690	12.840	12.109	7.809	13.617
„38	310722	255170	40378	10564	27959	644793	16.981	14.146	14.268	12.930	7.809	15.225
„39	317041	243641	47775	12402	24688	645548	15.136	13.650	13.428	12.984	8.235	14.461
„40	334033	258019	29347	11753	25244	658427	12.974	11.787	12.460	11.547	5.626	12.547
„41	364198	248313	20968	8999	24510	666990	13.153	12.505	12.213	9.088	6.709	12.885
„42	391451	212193	8648	3929	19425	635648	13.821	12.176	12.626	9.920	4.402	13.224
„43	393877	211127	4851	2606	16497	628970	13.491	11.712	12.611	9.750	3.139	12.859

Table 35. Yields of Rough Rice per *Tan* in Experiments.

Agr. Expt. Sta. Taihoku & Taichu, Taiwan

Crop Seasons	Native Varieties, 1919		Japanese Varieties, 1924-25		Number of Varieties, 1922-43	
	Number of Varieties	Average Yield of rough rice per *Tan*	Number of Varieties	Average Yield of rough rice per *Tan*	Number of Varieties	Average Yield of rough rice per *Tan*
		koku		*koku*		*koku*
First Crop	140	1.661	178	1.799	126	1.989
Second Crop	178	1.656	183	1.488	126	1.803
Average or Total	318	1.658	361	1.643	252	1.846

Table 36. Yields of Rough Rice per *Tan* in Taiwan (*koku*)

Dept. Agr. Comm., Gov. Taiwan

Crop Seasons	*Horai* Non-glutinous			Native Non-glutinous	*Horai* and Native Glutinous	Native upland Variety Glutinous & Non-glutinous
	Average (1936-38. 3 years)	Highest Record High yield Competition of all Taiwan (Agr. Assoc. Taiwan)		Average (1936-38. 3 years)	Average (1936-38, 3 years)	Average (1936-38, 3 years)
		1942	1943			
First Crop	1.636	5.071	5.346	1.436	1.288	0.833
Second Crop	1.380	5.980	7.003	1.237	1.227	0.848
Average or Total	1.503	11.051 (in the same field)	12.349 (in the same field)	1.336	1.257	0.843

Discussion about the Increase of Yield of Rough Rice per "ko" in Taiwan.

In Taiwan, during the past 45 years, the increase of about 93% in average is seen in the yield of rough rice per *ko* in one crop. According to the statistics, this actual amount is the same as that in Japan fifty years ago. Therefore a great possibility of the increase of harvest is preserved for the future. The increase of yield per *ko* in Taiwan has been much prompted by the distribution of Japanese varieties since 1922 and by the consequent distribution of new cross-bred *Horai* varieties, but the preparatory age until this time must not be neglected. The following is the general efforts of the government to aim at the increase of the yield per *ko* in Taiwan.

1. AFTER *1904*. Encouragement of the selection of the seeds to get large and plump seeds is as follows:—Selection should be done by strong wind 3-4 times, using fan separator and then it is desirable to select good seeds which have high specific weights using salt solution. After selection the seeds should be washed by water to take off the salt. The growers were exceptionally supplied cheap salt by the government.

Variety	Specific density of salt solution	Dose
Non glutinous	1.10-1.13	water 1 *to*, Salt 3-4 *sho* of 1.0-1.3 *kan*
Glutinous	1.08-1.10	water 1 *to*, Salt 2-4 *sho* or 0.8-1.0 *kan*

To=10 *sho*=18.03904 L ; *kan*=3.75 Kg.

2. AFTER *1906*. The execution of the enterprise to improve the native varieties, *i.e.* to select excellent varieties, to discard inferior ones, to do mass selection of the selected varieties, to propagate and distribute them; after 1915 pure line selections of these varieties.

3. AFTER *1907*. For the purpose of elevating the general technique of rice-growers, to encourage improved nursery making, to hold the exhibitions of nursery making and high yield competition, every crop, to lead general technique of rice-growers by these exhibitions, especially to transplant seedlings in proper spacing and rectangular way.

4. AFTER *1908*. To enact system of the inspection and extermination

of damages caused by diseases and insects.

5. AFTER *1908*. To encourage to plant green manure crops in winter, such as pea, soy bean, *Sesbania* and *Raphanus* sp. (Densei), single or mixed.

6. AFTER *1909*. To manage co-operative purchase of fertilizers in the agricultural association of each prefecture, to distribute fertilizer of good quality abundantly and in low prices.

These efforts were not limited only to a locality but were executed simultaneously in the whole island, making a local administrative territory a unit and they concentrated all their energies to increase rice-production. Thus the native variety took on a new aspect and rice growers showed a conspicuous elevation in the level of technique of intensive agriculture. Just about before and after the days of the appearance of *Horai* variety, the average yield per *ko* in one crop was 10.33 *koku* (1922), *i.e.* increase of about 45% to compare with 0.727 *koku* which was the average of five years from 1898 to 1902.

The highest record of yield of rough rice of the native variety (per *ko*) was 34.550 *koku*, Taichu Pref., 1917 (Table 37). In 1920 it was already proved by the native varieties that the days of nursery period greatly influenced the growth after transplanting, and to transplant young seedlings was profitable. In contrast to the past records of the experiments of Japanese varieties, the way to culture well the Japanese varieties in both crops by extremely shortening the nursery period was made clear and was accomplished.

The rapid development of planted area of the Japanese varieties, consequently the *Horai* varieties, and the solid foundation of the production of *Horai* rice in this island were quite due to the level of technic in rice-culture which was intensively developed, and they were never accidental. Therefore even today the record-breaking highest yield is in Taichu Prefecture as shown in Table 38.

Table 37. The Highest Records of the Yields of Rough Rice of the Native Varieties.
High yield competition, Agr. Assoc. Taichu.

Year	Crop seasons	Yields of rough rice per *ko* (*koku*)	Prefecture and districts	Varieties
1917	Second Crop	34.550	Taichu pref. Tosei dist.	Native
1918	First Crop	34.815	Taichu pref. Sharaku dist.	Native
1918	Second Crop	31.185	Taichu pref. Inrin dist.	Native

Table 38. The Highest Records of the Yields of Rough Rice per *ko* in Taiwan.

1. High yield competition, Agr. Assoc. Taiwan

Order	Yields of rough rice per *ko* (*koku*)						Prefectures and districts of Reward winners of prize			
	First Crop		Second Crop		Total in the Same field		1942		1943	
	1942	1943	1942	1943	1942	1943	Prefectures	Districts	Prefectures	Districts
1	49.596	52.288	58.485	68.496	108.081	120.784	Taichu	Shoka	Taichu	Inrin
2	52.985	48.440	53.919	59.936	106.904	108.026	〃	Inrin	〃	Hokuto
3	59.481	52.026	43.504	45.770	102.985	97.796	Tainan	Toroku	〃	Tosei
4	52.736	45.281	57.251	44.903	99.987	90.184	Shinchiku	Toen	〃	Shoka
5	47.780	55.279	41.011	31.384	88.791	86.663	Taichu	Toyohara	〃	〃
6	40.590	54.472	37.851	31.704	78.441	86.176	〃	Nanto	Tainan	Kobi
7	39.643	40.395	36.479	38.971	76.122	79.366	Shinchiku	Taiko	Taichu	Daiton
8	45.508	46.919	27.857	31.369	73.365	78.288	〃	Chikunan	Takao	Hozan
9	42.178	46.099	29.841	29.047	72.019	75.146	Takao	Hozan	〃	Choshu
10	41.178	40.305	29.384	32.028	70.562	72.353	Taichu	Inrin	Shinchiku	Chikuto

2.

Crop Season	Year	Yield of rough rice per *ko* (1.8039 hl)			Number of points (one point per district)	Varieties (Number of points)
		Average	Min.	Max.		
First Crop	1942	39.017	20.175	59.418	27	Taichu No. 150(12), Kanan No. 2(4), Taichu No. 154(4) Taichu No. 65(9), Taihoku No. 8(1)
	1943	42.501	32.262	55.279	30	Taichu No. 150(12), Taichu No. 153, Taichu No. 155(1), Taichu No. 65(6), Kanan No. 2(1), Kanan No. 8(3), Takao No. 18(2), Takao No. 16(3), Taino No. 45(1)
Second Crop	1942	41.558	27.855	58.485	10	Taichu No. 150(2, Kanan No. 2(1), Taichu No. 154(1), Taichu No. 65(6)
	1943	40.013	26.892	68.496	11	Taichu No. 65(7) Kanan No. 8(2), Takao No. 1½ (2)
Total	1942	87.726	70.562	108.801	10	Alt Horai varieties
	1943	87.567	68.453	120.784	11	

3.

Crop season	Year	Days of nursery period			Amount of seeds per *tsubo* (*go*=1/1000 *koku*)		
		Average	Min.	Max.	Average	Min.	Max.
First Crop	1942	33.071	25	45	4.49	2.5	4.8
	1943		30	40	2.97	0.6	5.0
Second Crop	1942	17.714	13	13	2.05	1.5	3.5
	1943		13	13	3.14	2.0	5.0

4.

Crop season	Year	Depth of plowing (*Shaku*=0.30303 m)			Number of clumps per *tsubo*, Spacing		
		Average	Min.	Max.	Average	Min.	Max.
First Crop	1942	—	0.80	1.50	72.35	55.6	90.0
	1943	1.31	0.80	2.50	79.04	46.0	101.4
Second Crop	1942	—	0.60	1.80	83.54	58.5	108.8
	1943	1.24	0.80	2.00	77.34	62.5	90.0

5.

Crop season	Year	Fertilizer applied per *ko* (*kan*=3.75 kg.)					
		N				P_2O_5	
		Average	Max.	Min.	Percentage of Farm manure	Average	Max.
First Crop	1942	165.288 (100)	880.323	39.703	61.68	137.394 (83)	776.413
	1943	269.329 (100)	600.472	85.612	71.90	281.116 (73)	397.580
Second Crop	1942	90.305 (100)	195.415	12.580	51.95	69.502 (77)	182.750
	1943	250.467 (100)	599.560	122.062	67.30	228.521 (91)	551.008

Crop season	Year	Fertilizer applied per *ko*, (*kan*=3.75 kg.)					
		P_2O_5		K_2O			
		Min.	Percentage of Farm manure	Average	Max.	Min.	Percentage of Farm manure
First Crop	1942	24.943	76.01	198.760 (120)	779.403	17.808	84.94
	1943	68.949	70.10	426.972 (143)	857.573	77.728	78.90
Second Crop	1942	7.410	64.42	112.328 (124)	354.856	3.384	74.33
	1943	76.902	62.46	461.882 (183)	774.189	156.522	71.80

The conspicuous points found in these results of high yield competitions are that *Horai* varieties are far more efficient and productive than the native varieties in intensive culture with abundant fertilizer, and the highest record belongs to the second crop.

6

	Yield of rough rice per *ko* (*koku*)		Index of yield	
	Horai variety	Native variety	*Horai* variety	Native variety
Highest record	68.496	34.815	196.77	100.00
Highest record in first Crop	59.418	34.815	173.54	100.00
Highest record in second Crop.	68.496	34.550	193.24	100.00
Average of prize-winner's yields	87.597	33.516	261.36	100.00
Average of yields accepted for the high yield competition. (Agr. Assoc. Taiwan)	40.772	33.516	121.67	100.00

The highest record of the yield of rough rice in Japan is 8.401 *koku* per *tan* (1929) and it is considered to be the highest in the world. To convert *tan* into *ko*, the yield is 82.162 *koku* per *ko*. This is the production of one year in the case of one-crop a year, as it takes seven months from sowing and transplanting to harvesting.

The highest record in Taiwan is 68.496 *koku* in the second crop. The period from sowing and transplanting to harvesting of two crops a year is about ten months, so if the yield of the first crop in the same field is added to that 68.496 *koku*, the total yield a year in the same field is 120.784 *koku*. The index-number is 147.12 if that of Japan is 100.

In the whole Taichu prefecture including cities, the average yield per *ko* gradually increases according to the expansion of the planted area to culture the Japanese varieties and new *Horai* varieties after 1922. As a result the increase is from 11.247 *koku* in 1921 to 18.495 *koku* in 1938 (the common non-glutinous rice :- *Horai* varieties 19.759 *koku*, the native varieties 16.961 *koku*).

But after 1938, through the influence of the war it was difficult to get fertilizer and implements for production and there was lack of agricultural labour. In addition to these difficulties, as the planted area of sugar cane expanded to the high producing regions of the rice, even though a great deal of efforts in technique to increase the rice production was paid and there was a record high yield, in general the average yield per *ko* had tended to decrease gradually and the difference between the yield per *ko* of *Horai*

variety and that of the native variety had been reduced. Therefore, here the writer shows the yield per *ko* in each administrative section in Taichu Prefecture in the boundary years 1938-1939 when this tendency became conspicuous.

Table 39. Average Yields of Rough Rice per *ko* in Taichu Prefecture.

Year	*Horai* Common rice					Native Common rice (Except'( ))				
	Planted area (*ko*)		Yield of rough rice per *ko* (*koku*)			Planted area (*ko*)		Yield of rough rice per *ko* (*kokn*)		
	First crop	Second crop	First crop	Second crop	average	First crop	Second crop	First crop	Second crop	average
1922	1.60		13.750	—	13.750	(65927.59	62899.12	13.647	12.322	13.000)
1923	161.69	166.69	14.664	16.924	15.811	(64885.30	62578.59	12.450	10.437	11.462)
1924	3343.03	6999.98	16.683	12.726	14.128	(65699.22	63184.03	14.270	12.717	13.509)
1925	18723.24	7306.43	17.252	10.323	15.307	(67927.05	66552.17	14.788	12.486	13.649)
1926	37907.13	6389.97	10.358	12.682	10.694	(70056.39	68233.96	11.544	12.741	12.135)
1927	18664.54	14658.96	15.671	12.767	14.393	(71082.12	70179.77	14.260	12.914	13.591)
1928	32466.74	17815.50	14.480	11.774	13.521	(72758.12	70310.35	13.819	12.722	13.200)
1929	21663.71	14580.17	14.971	12.801	14.098	(61723.26	69754.74	14.290	12.817	13.501)
1930	28865.30	25692.10	15.788	12.233	14.114	(74567.23	72892.98	14.839	12.192	13.530)
1931	32379.40	24574.46	16.310	11.601	14.279	(75703.47	75257.13	15.065	12 005	13.639)
1932	43319.97	30481.38	18.514	13.097	16.276	(81549 12	80384.86	16.998	13.257	15.141)
1933	51934.28	33046.69	16.771	16.877	15.646	(83339.70	81711.44	16.633	13.042	14.855
1934	55646.57	38203.22	18.962	14.675	17.217	20854.61	28525.94	16.065	13.801	14.757
1935	67367.39	39218.98	17.539	14.385	15.962	(87214.48	82166.62	16.693	14.168	15.431
1936	64089.80	39991.13	19.125	14.387	17.303	(89593.98	84035.13	17.984	14.093	16.100
1937	64070.60	38661.52	18.838	14.079	16.459	(87515.33	81644.78	17.845	13.922	15.884)
1938	56975.28	366(2.23	21.615	16.871	19.759	20537.78	30564.44	18.596	15.861	16.961
1939	49142.12	44514.74	18.320	15.882	17.160	21441.18	28761.54	16.460	15.273	15.780
1940	50613.49	38556.22	18.932	11.116	15.553	25110.90	35735.70	17.189	11.400	13.789
1941	54593.74	42751.44	16.297	12.845	14.788	26581.51	31704.60	13.902	12.564	13.175
1942	54144.90	44172.81	16.125	13.663	15.014	23816.88	33923.81	15.064	12.284	13.430

Table 40. Average yield of Rough Rice per *ko* in the various Intensiveness of

Districts			*Horai* Common Rice				
			Non-glutinous variety			Glutinous variety	
			First crop	Second crop	Average	First crop	Second crop
Taichu-shi	臺中市	Taichung-shih	24.759 22.495	21.328 19.025	24.045 21.664	22.646 24.615	19.353 19.271
Shoka-shi	彰化市	Changhisa-chü	24.873 20.251	23.611 20.274	24.418 20.260	21.564 20.657	21.208 18.037
Daiton-gun	大屯區	Daitun-chü	22.962 22.601	19.377 18.011	21.996 20.599	22.538 22.249	18.219 16.838
Toyohara-gun	豐原區	Fengoüan-chü	21.156 20.035	18.104 17.753	19.664 18.792	20.671 18.148	16.741 16.005
Tosei-gun	東勢區	Tangshih-chü	20.265 18.545	16.082 15.510	19.712 17.486	19.904 18.492	17.189 16.546
Taiko-gun	大甲區	Daichia-chü	21.341 19.028	14.917 15.991	18.978 17.812	22.317 19.598	15.603 16.624
Shoka-gun	彰化區	Changhua-chü	23.548 15.680	17.294 15.312	21.260 15.520	22.105 15.731	17.305 17.632
Inrin-gun	員林區	Yünlin-chü	21.683 18.162	17.281 16.065	19.902 17.124	20.722 17.537	15.809 17.781
Hokuto-gun	北斗區	Peitou-chü	18.551 16.068	15.234 13.735	16.914 14.726	17.933 16.855	14.609 14.106
Nanto-gun	南投區	Nantou-chü	21.675 19.304	17.290 16.393	19.982 17.700	21.089 16.431	17.003 17.936
Niitaka-gun	新高區	Hsinkao-chü	17.767 19.023	14.465 12.905	16.697 15.565	16.294 17.800	15.673 12.958
Noko-gun	能高區	Nengkao-chü	14.288 13.130	16.281 10.073	14.779 13.422	14.492 17.531	13.606 12.460
Takeyama-gun	竹山區	Chu shan-chü	19.784 17.288	16.046 14.046	18.209 15.710	17.285 17.124	14.995 14.487
Average			21.615 18.320	16.871 15.882	19.759 17.160	20.612 18.488	17.160 16.806
Total average			19.9675	16.3765	18.4595	19.5500	16.9830
per *cho*			20.4168	16.7456	18.8748	19.9899	17.3651

Remarks: Upper numbers--1938, Under numbers--1939

Districts of Taichu Prefecture, showing the Differences of Culture. (*koku*)

	Native Common Rice					
	Non-Glutinous Variety			Glutinous variety		
Average	First crop	Second crop	Average	First crop	Second crop	Average
19.438	20.509	17.833	18.925	18.400	16.883	17.822
19.565	19.600	17.729	18.832	18.103	18.182	18.170
21.305	22.828	23.040	23.013	20.588	21.036	21.012
18.479	20.826	18.355	18.711	18.657	17.875	18.258
18.413	20.577	17.314	18.742	20.692	18.474	19.494
17.238	19.489	16.582	18.278	19.906	15.178	18.237
17.025	21.123	18.306	20.075	19.700	17.144	18.674
16.024	19.060	16.600	18.036	16.969	15.884	16.310
17.503	16.604	14.492	15.346	11.111	12.981	12.979
16.847	15.476	13.895	14.505	—	13.682	13.682
16.918	19.722	15.417	17.031	21.523	15.076	17.662
16.859	17.475	17.897	17.756	18.554	16.997	17.702
18.464	22.460	16.713	18.350	21.856	17.480	19.778
16.797	17.032	15.368	15.940	14.572	17.157	15.637
18.091	20.825	17.452	18.587	18.182	15.384	15.534
17.709	18.528	17.763	18.039	16.143	16.794	16.728
16.085	16.740	12.423	14.671	13.286	12.371	12.787
15.064	12.990	11.990	12.520	10.607	13.907	11.189
17.585	17.876	16.684	17.143	19.759	17.829	18.429
17.780	17.990	18.514	18.214	15.689	16.225	15.997
15.904	12.823	11.936	12.290	13.202	11.480	11.631
13.822	13.156	11.251	12.060	13.962	10.924	11.137
13.882	14.708	13.456	14.016	14.691	12.153	12.364
13.552	12.160	11.787	11.780	9.195	9.703	9.690
16.391	14.173	12.800	13.360	8.766	10.932	10.210
15.406	12.899	11.033	11.758	8.825	10.883	10.106
17.428	18.569	15.861	16.961	17.527	14.072	14.956
17.041	16.460	15.273	15.780	14.026	13.106	13.345
17.2345	17.5280	15.5670	16.3705	15.7765	13.5890	14.1505
17.6223	17.9224	15.9173	16.7384	16.1313	13.8948	14.4689

Planted areas (*ko*)

Year	Crop season	Horai Rice		Native Rice		Total	All total with upland Rice
		Non-glutinous	Glutinous	Non-glutinous	Glutinous		
1938	First crop	56975.28	698.85 (9.97)	20537.78	265.31	78487.19	80239.62
	Second crop	36620.23	5694.84 (2734.16)	30564.44	771.20	7636 .87	76503.43
1939	First crop	49144.72	1109.75 (7.14)	21441.26	285.94	71941.67	73267.98
	Second crop	44517.85	8788.15 (869.97)	28854.68	818.24	83851.89	83860.49

( ) Planted areas of native glutinous variety, included in planted areas of *Horai* variety.

Notes.

The non-glutinous *Horai* varieties:—The first crop is 2.042 *koku* reaching the 1936-40 line in Japan (2.056 *koku*), but the second crop is 1.675 *koku* about on the 1908-21 line (1.700 *koku*). The reasons why the 2 nd crop is inferior to the lst crop are these. Compare the season of the 2 nd crop with that of the lst crop In the nursery period of the 2 nd crop, day-length is longer and temperature is higher, and after the transplanting short day-length and high temperature. Therefore it is necessary to shorten extremely days of nursery. However the technique is not fully diffused, transplanting time is not proper, quantity of fertilizer tends to be less than in the first crop.

The average yield of both crops is 1.887 *koku*, reaching the 1918-22 line (1.888 *koku*). It may be considered that the glutinous variety is in accordance with the non-glutinons.

The non-glutinous native varieties:—The first crop is 1.792 *koku*, about on the 1913-17 line (1.808 *koku*), and the second crop is 1.592 *koku* on the 1908-12 line (1.604 *koku*).

The average of both crops is 1.674 *koku*. It may be recognized that it approaches to the 1908-12 line, and the glutinous is in accordance with this and shows more inferior results.

To get an average of both crops, the order of the average yield of *Horai* rough rice, both non-glutinous and glutinous per *ko* is this:

The first rank.....Taichu City, Shoka City

The second rank...Toyohara district, Daiton District, Tosei district, Inrin district, Shoka district.

The native varieties:—non-glutinous

The first rank.....Shoka City, Toyohara district, Taichu City.

The second rank...Daiton district, Inrin district.

Glutinous

The first rank.....Shoka City, Daiton district

The second rank...Taichu City, Shoka district, Taiko district.

Table 41. Numbers of Higher and Lower Yielded Prefectures in Japan or Districts in Taichu Prefecture, Taiwan than Average Yield per *tan* in Japan.

1.

	Average yield of non-glutinous rough rice in Japan 2.105 *koku* per *tan*, 1938			Average yield of glutinous rough rice in Japan 1.902 *koku* per *tan*, 1938		
	Japan Japanese Varieties	Taichu, Taiwan *Horai* Varieties	Taichu, Taiwan Taiwan Native Varieties	Japan Japanese Varieties	Taichu, Taiwan *Horai* Varieties	Taichu, Taiwan Taiwan Native Varieties
	ken (prefecture)	gun (district)	gun	ken	gun	gun
Number of higher yielded prefectures or districts than average yield.	26	4	1	23	2	2
" Index %	55.3	30.7	7.7	48.9	15.3	15.3
Number of lower yielded prefectures or districts than average yield.	21	9	12	24	11	11
Total	47	13	13	47	13	13

2.

	Non-glutinous rough rice per *tan* (*koku*)				Glutinous rough rice per *tan* (*koku*)			
	Horai or Japanese Varieties		Taiwan Native Varieties		*Horai* or Japanese Varieties		Taiwan Native Varieties	
	Average	Max.	Average	Max.	Average	Max.	Average	Max.
Japan	2.105	2.779 Saga-ken	—	—	1.902	2.927 Kana-gawa-ken	—	
Taichu pref. Taiwan	1.887	2.442 Shoka-shi	1.674	2.301 Shoka-shi	1.718	2.131 Shoka-shi	1.447	2.101 Shoka-shi

When one observes each prefecture, he will find the following facts. Locally in each prefecture the technique of rice-growers has progressed and the high yield per *ko* is produced here and there. But when he observes the prefectures in general, he recognizes Taichu Prefecture is the best. That is, its rice production is the largest and the level of rice planting technique of general farmers is comparatively high. As shown in the above-mentioned table, the average yield of *Horai* varieties approaches to that per *tan* of Japan in the same year. The yield per *tan* in the sections (Gun and Shi) of high yield ranks with the prefectures (Ken) of high yield in Japan. However as the ratio of the number of low-yield-sections to that of high-yield-sections is higher than that in Japan, the yield of the native variety per *ko* is inferior to *Horai* varieties and these are added to the average number, the all total

average per *ko* gets lower. This was an unavoidable thing in such a period of transition when the plantation of *Horai* varieties was rapidly spread. All the statistic figures show that in intensive culture of abundant fertilizer the yield of *Horai* varieties is far greater than that of the native variety. These phenomena are not limited only to Taichu Prefecture. They are recognized all through the island.

As above-mentioned, there are many things to be expected of the plantation of *Horai* varieties for the purpose of increasing the rice production in Taiwan. But for that these conditions are necessary, *i. e.*, an abundant supply of cheap fertilizer of good quality, to get cheap and good implements and other materials for the production, the elevation of the level of the general technique in culture, and to regulate fairly the rice-market. If the rate of increase of *Horai* rice production by the intensive method can not bring comparatively high profit to the invested capital and labour, the plantation of *Horai* varieties may not be executed administratively. On the contrary it is rather profitable to plant the native variety.

For instance one may regard the rice plant as a living machine to be able to produce rice, excellent varieties as a delicate one of high efficiency, the rice-field as a factory. Accordingly if materials are not fully supplied, the highest technique is not used, environmental conditions are neglected and then the machine is operated in vain, the profit and producing efficiency of the factory are not achieved. It is also important conditions to improve the rice-field and elevate the producing efficiency by the improved equipment of irrigation and drainage. The level of cultural technique should be elevated higher and never be fallen below the present level. Taiwan, a densely populated small island, should be in the extent of more development of agricultural science than before because her prosperity greatly depends upon the agricultural products and the rice is not only the biggest in this field but it was the biggest exporting product until recent times. This is not limited only in the case of Taiwan or *Horai* varieties. The past efforts for the plantation of *Horai* varieties have also prompted the progress of the technique in planting the native variety. The writer wonders if in the case of Kiangsu rice of the so-called Keng-type, its good quality and high yield are because these conditions are satisfied naturally or artificially.

Appendix.

1. Local planting Seasons of the Native

Localities (gun or Si)			First Crop	
			Sowing	Transplanting
Taihoku	臺北	Taipei	Jan. 11-20	Mar. 1-10
Hichisei	七星	Chi hsing	„ 1-30	Feb. 21-Mar. 20
Tansui	淡水	Tan shui	„ 11-Feb. 10	Mar. 11-Apr. 10
Kiehlung	基隆	Chi lung	„ 11-Feb. 20	Mar. 1-Apr. 20
Giran	宜蘭	Jlan	Dec. 21-Jan 20	Feb. 11-Mar. 10
Rato	羅東	Latung	Jan 11-30	Mar. 1-30
Suo	蘇澳	Suao	Feb. 1-10	„ 11-20
Bunzan	文山	Wênshan	„ „	„ „
Kaizan	海山	Hai shan	Jan. 11-30	„ 1-20
Shinsho	新莊	Hsinchuang	„ 11-20	„ 1-10
Shinchiku	新竹	Hsinchu	Jan. 1-Feb. 20	Mar. 1-Apr. 20
Chureki	中壢	Chung li	Jan. 11-Feb. 10	Mar. 11-20
Toen	桃園	T'aoyuan	Dec. 21-Feb. 10	„ 1-30
Taike	大溪	Daihsi	Jan. 1-20	„ 11-20
Chikuto	竹東	Chutung	„ 11-20	„ 11-30
Chikunan	竹南	Chunan	„ „	„ „
Byoritsu	苗栗	Miaoli	„ „	„ „
Taikô	大湖	Daihu	Dec. 21-Jan. 30	Feb. 11-Mar. 30
Taichu	臺中	Tai chung	Jan. 1-10	Feb. 11-20

Varieties of Rice in Taiwan, 1926.

		Second Crop					
Harvesting		Sowing		Transplanting		Harvesting	
July	1-10	June	11-20	July	21-30	Nov.	11-20
June	21-30	〃	1-10	〃	11-20	〃	1-10
July	1-30	〃	21-30	〃	21-30	〃	〃
〃	〃	〃	11-20	〃	11-20	〃	11-20
〃	11-30	〃	1-10	〃	21-30	〃	〃
June	21-30	〃	〃	〃	〃	〃	1-10
July	1-10	〃	〃	〃	11-20	〃	〃
〃	11-20	〃	11-20	〃	21-30	〃	11-20
June	21-30	〃	〃	〃	11-20	Oct.	21-30
〃	〃	〃	1-10	〃	〃	〃	〃
June	21-July20	〃	12-30	〃	21-30	Nov.	1-10
July	1-10	June	1-10	July	11-20	〃	1-10
June	1-July10	〃	〃	〃	21-30	〃	〃
June	21-30	〃	〃	〃	〃	〃	〃
July	11-20	〃	11-20	Aug.	1-10	〃	11-20
〃	1-10	〃	〃	July	21-30	〃	1-10
June	21-JuIy10	〃	11-30	〃	〃	〃	〃
June	21-July10	〃	11-20	〃	〃	〃	〃
June	21-30	July	1-10	〃	〃	〃	〃

Daiton	大屯	Daitun	Dec. 21-Jan.20	Feb.11-Mar.10
Toyohara	豐原	Fengoüan	Dec. 21-Jan.10	Feb. 11-20
Tosei	東勢	Tun shih	Dec. 21-30	〃 1-20
Taiko	大甲	Daichia	Jan. 21-Feb.20	Mar.11-Apr.10
Shoka	彰化	Chang hua	Jan. 11-Feb.20	Mar. 1-30
Inrin	員林	Yünlin	Jan. 20-Feb.28	Mar.11-Apr.30
Hokuto	北斗	Peiton	Jan. 11-20	Mar. 1-10
Nanto	南投	Nzntiou	〃 1-30	〃 1-30
Niitaka	新高	Hsinkao	Dec. 21-Jan.10	Feb. 11-23
Noko	能高	Neng kao	Dec 21-30	〃 21-28
Takeyama	竹山	Chu shsn	〃 〃	〃 〃
Tainan	臺南	Tainan	Jan. 1-10	Mar. 11-20
Niitoyo	新豐	Hsifeng	Nov. 1-Jan.20	Dec. 11-Feb.28
Sinka	新化	Hsin hua	Nov.21-Feb.20	Jan. 1-Apr.10
Sobun	曾文	Chen wên	Nov, 21-Dec.20	Jan. 1-Feb.20
Shinei	新營	Sinying	Mar. 1-20	Apr. 11-30
Kagi	嘉義	Chiai	Feb. 1-23	Mar.11-Apr.20
Toroku	斗六	Touliu	Jan. 21-Feb 10	Mar. 11-20
Kobi	虎尾	Huwei	Feb. 1-10	Mar.21-Apr.10
Tosheki	東石	Tung shih	Jan. 1-Mar.10	Feb. 21-Apr.20
Hokko	北港	Pei kang	Jan. 1-20	Mar. 21-30
Takao	高雄	Kao hsiung	Dec. 11-20	Jan. 21-30
Okayama	岡山	Kan shan	Nov.21-Dec.10	Jan. 1-Feb.10

June	11-30	July	1-10	Aug.	1-10	Nov.	11-20
〃	〃	〃	〃	〃	〃	〃	〃
〃	〃	June	21-30	July	21-30	〃	〃
July	1-20	July	11-20	Aug.	1-10	Oct.	21-30
June	21-July 30	June	21-30	July	21-30	Nov.	11-20
June	1-20	〃	〃	〃	〃	〃	〃
June	1-July 20	〃	〃	Aug.	1-10	〃	21-30
June	21-30	〃	11-20	July	21-30	〃	11-20
June	21-July 30	〃	21-30	〃	〃	〃	21-30
June	11-20	〃	〃	〃	〃	〃	11-20
July	1-10	〃	〃	〃	〃	〃	〃
June	1-10	〃	〃				
May	21-June 30	May	21-30	July	21-30	〃	〃
May	11-July 20	June	21-30	Aug.	1-10	〃	〃
May	21-June 10	〃	1-10	broadcasting		〃	〃
July	21-Aug 10	〃	21-30	July	21-30	〃	〃
July	1-20	〃	1-30	〃	1-30	〃	21-30
〃	11-20	〃	21-30	〃	21-30	〃	〃
June	11July 10	〃	〃	〃	〃	〃	〃
July	1-Aug 10	July	1-0	Aug.	1-10	〃	11-20
July	11-20	June	21-30	〃	〃	〃	〃
May	21-30	〃	11-20	July	21-30	〃	11-20
May	21-June 20	〃	〃	Aug.	11-20	〃	1-10

Hozan	鳳 山	Fêng shan	Dec.	1-30	Jan.	21-30
Kizan	旗 山	Ch'i shan	〃	1-10	Feb.	21-28
Heito	屏 東	P'ing tung	〃	11-20	〃	11-20
Choshu	潮 州	Ch'ao chow	〃	〃	Jan.	11-30
Toko	東 港	Tung kang	〃	〃	〃	〃
Koshun	恒 春	Hêng ch.un	〃	〃	Feb.	1-10
Taito	臺 東	Taitung	Jan.	21-30	Mar.	11-20
Shinko	新 港	Hsin ksng	〃	11-20	〃	〃
Karen	花 蓮	Hualien	〃	1-30	Mar.	1-30
Tamasato	玉 里	Yüli	〃	21-30	〃	11-20

Remark: Numbers, showing decades of months, i.e. 1-10=First decade, 11-20=second

2. Taiwan cities and

Old reading			New reading	Old reading	
Taihoku	臺	北	Taipei	Tosei	東
Toen	桃	園	Taoyuan	Taiko	大
Shinchiku	新	竹	Hsinchu	Inrin	員
Chikuto	竹	東	Chutung	Hokuto	北
Taichu	臺	中	Taichung	Nanto	南
Shoka	彰	化	Changhwa (hua)	Niitaka	新
Daiton	大	屯	Tatun	Noko	能
Toyohara	豐	原	Fengyuan	Takeyama	竹

May	21-30	June	1-10	July	11-20	Nov.	21-30
June	1-10	„	11-20	„	21-30	„	11-20
„	„	May11-June10		„	11-20	„	21-30
May	21-30	June	21-30	„	21-30	„	„
„	„	„	11-20	„	„	„	11-20
gune	1-10	„	21-30	„	„	„	„
guly	1-10	July	1-10	Aug.	11-20	„	„
„	„	„	11-20	„	„	Dec.	1-10
„	1-30	June	21-30	July	21-30	Nov.	11-20
„	1-0			Aug.	11-20	„	21-30

decade 21-30=third decade

districts Romanized

New reading		Old reading	New reading		
勢	Tungshih	Kagi	嘉	義	Chiai
甲	Taichia	Seira	西	螺	Hsila
林	Yuanlin	Tainan	臺	南	Tainan
斗	Peitou	Tokao	高	雄	Kaohsiung
投	Nantou	Heito(Ako)	屏	東	Pintung (Akou)
高	Hsinkao	Karen (ko)	花	蓮 (港)	Hwalien
高	Nengkao	Taito	臺	東	Taitung
山	Chushan	Kielung	基	隆	Chilung

3. Chinese Cities Romanized.

Nanking	南京	Luchow	廬州(合肥)	Kweichow	貴州省	Liaoning	遼寧省
Shanghai	上海	Nanling	南陵	Kweiyang	貴陽	Antung	安東
Peiping	北京	Ningkwo	寧國	Yunnan	雲南省	Dairen	大連
Tientsin	天津	Sanho	三河	°Yunanfu	雲南府	Fushan	撫順
Tsingtao	青島	Siangan	襄安	Kwangtung	廣東省	Hsiungyueh-cheng	熊岳城
Kiangsu	江蘇省	Siho	西河	Chaochow	潮州	Hwaijen	桓仁
Changchow	常州	Suancheng	宜城	°Canton	廣東	Kwantien	寬甸
Changshu	常熟	Taihu	太湖	Kwanchow	廣州	Liaoyang	遼陽
Chingkiang	鎭江	Taiping	太平	Kayingchow	嘉應州	Mukden	奉天
°Hinghwa	興化	Tangtu	當塗	Shinchow	韶州	Tangkungtze	湯崗子
Ihing	宜興	Tashou	大手	Sanshui	三水	Tiehling	鐵嶺
Kiangnin	江寧	Wanchih	灣趾	Waichow	惠州	Yigkow	營口
Kiating	嘉定	Wuhu	蕪湖	Kwangsi	廣西省	Shantung	山東省
Kintan	金壇	Wuwei	無爲	°Nanning	南寧	°Weihaiwei	威海衛
Kunshan	崑山	Yungchiachen	雍家鎭	Fukien	福建省	Shansi	山西省
Lianyang	梁陽	Yungsao	運漕	Amoy	廈門	°Taiyuan	太原府
Nantung	南通	Kiangsi	江西省	Chahgpu	漳浦	Shensi	陝西省
Soochow	蘇州	Ani	安義	Changchow	漳州	°Sian	西安
Sungkiang	松江	Fuchow	撫州	Chuanchow	泉州	Hopei	河北省
Taichow	泰州	Hsinchien	新建	Diongloh	長樂	°Paoting	保定
Taitsang	太倉	Hsinchang	新昌	°Foochow	福州	Honan	河南省
Tanyang	丹陽	Hsinfeng	新豐	Hinghwa	興化(莆田)	Kaifeng	開封
Tsingkiang	靖江	Kian	吉安	Kienning	建寧	Kansu	甘肅省
Wukiang	吳江	°Nanchang	南昌	Lienkong	連江	°Langchow	蘭州
Wush	無錫	Wuning	武寧	Lungyen	龍巖	Ningsia	寧夏省
Yencheng	鹽城	Hupeh	湖北省	Shaowu	邵武	Sikang	西寧省
Chekiang	浙江省	Anlu	安陸	Yenping	延平	°Batang	巴塘
Chüchow	衢州	Chianghsia	江夏	Suiyuan	綏遠省	Sinkiang	新疆省
°Hangchow	杭州	Chingshan	青山	°Kweihwating	歸化廳	°Tihwa	廸化
Huchow	湖州	Hangkow	漢口	Chahar	察哈爾省	Kokonor	青海省
Kashing	嘉興	Hwangchow	黃州	°Changkiahow	張家口	°Sinin	西寧
Kinhwa	金華	Ichang	宜昌	Jehol	熱河省	Mongolia	蒙古地方
Ningpo	寧波	Kihgchow	荊州	°Chengteh	承德	°Urga	庫倫
Shaohing	紹興	Singyang	襄陽	Hellungkiang	黑龍江省	Tibet	西藏地方
Taichow	臺州	°Wuchang	武昌	°Tsitsihar	齊齊哈爾	°Lhaso	拉薩
(Linhai)	(臨海)	Hunan	湖南省	Kirin	吉林省		
Yenchow	嚴州	°Chngsha	長沙	Changchun	長春		
Yüyao	餘姚	Changteh	常德	I-Mienpo	一面坡		
Wenchow	溫州	Chuchow	衢州	°Kirin	吉林		
Anhwei	安徽省	Yochow	岳州	Kwanchengtze	寬城子		
Anking	安慶	Yungchow	永州	Mutankiang	牡丹坑		
Chekao	柘皐	Chechwan	四川省	Tunhwa	敦化		
Fangtsun	方村	°Chengtu	成都	Shanchengtze	山城子		
Hochow	和州	Chungking	重慶	Yushu	榆樹		

4. Chinese readings of Korean Native Varieties.

Aidachi	Aita	8-sho-to (Hassho-to),	Pasheng-tao	Sei-so,	Cheng-chu
Baku-so	Mai-Chu	Kai-so,	Hai-chu	Sekizan-so,	Shihshan-chu
Bei-so,	Mi-chu	Kyo-so,	Ching-chu	7-sho-to (shichisho-to),	Chishung-tao
Chu-so,	Chung-chu	Mu-so,	Mow-chu Moú-chu	Shukakuretsu,	Shouhulieh
En-an-so,	Yenanchu	Rei-to,	Leng-to	Sotei-so,	Tsaoting-chu
Getsu-so,	Yueh-Chu	Rojin-to,	Laojentao	Tō-chu,	Touchung
Haku-so,	Pai-Chu	Ryokuto-so,	Luton-chu	To-so,	Tou-chu
Hakusen-so,	Paichwan-chu Paichuan-chu	Ryusen,	Langchwan	Wai-so,	Wei-chu

5. Weights and measures

Ko (2934 *tsubo*)	*Cho* (10 *tan*, 3000 *tsubo*)	ha.
1.	0.978	0.9699
1.0225	1	0.9917
1.0310	1.0083	1

Shaku (10 *sun*, 100 *bu*)	m.
1.	0.30303
3.3	1

Kan (6.25 *kin*, 1000 *monme*	Kg.
1.	3.37
0.26667	1

Koku (10 *to*, 100 *sho*, 1000 *go*)	hl.
1.	1.80391
0.54352	1

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